THE EFFECTS OF DIFFERENTIAL REINFORCEMENT ON VARIABLE AND NOVEL

PRETEND PLAY BEHAVIORS OF CHILDREN WITH AUTISM

By

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Submitted to the graduate degree program in Applied Behavioral Science and the Graduate Faculty of the University of Kansas in partial fulfillment of the requirements for the degree of Master of Arts.

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Abstract

Play is important in the development of every child. A deficit in appropriate play skills is commonly associated with a diagnosis of autism spectrum disorder (ASD). As such, play skills are often a target of comprehensive intervention programs for young children with ASD. Many different approaches have been used within the context of comprehensive interventions to teach pretend play skills to children with autism, but a limited number of these studies focus specifically on increasing variable or novel play behaviors. The goal of the present study was to use differential reinforcement of novel and variable responses to teach three preschoolers with autism to engage in a variety of pretend play behaviors. A multiple baseline design across participants and playsets was used. Appropriate pretend play behaviors were differentially reinforced based on whether the behavior occurred for the first time in a session or for the first time in the study. Results showed increases in variability of pretend play behavior, engagement in novel behavior, use of novel play objects per session, and engagement in appropriate play as compared to baseline levels across all children and almost playsets. These findings indicate that differential reinforcement can be used to increase variability of appropriate pretend play behavior of children with autism.

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The Effects of Differential Reinforcement on the Variable and Novel Pretend Play Behaviors of Children with Autism

Play is extremely important in the successful development of every child (Jung & Sainato, 2013; Lang et al., 2009). Researchers have suggested that play serves many roles for young children. For example, play helps lay a foundation for social interactions and leisure skills that may benefit children later in life (Barton & Wolery, 2008). Further, play provides a context for young children to learn and practice communication skills and problem solving skills in a natural setting and has been linked to social, cognitive, physical and emotional development (Dupere, MacDonald, & Ahearn, 2013; Fragale, 2014; Holmes and Willoughby, 2005; Jung & Sainato, 2013; Lifter, Foster-Sanda, Arzamarski, Briesch, & McClure, 2011).

Often, play is described in various overlapping categories such as games, sensorimotor play, functional play, and pretend play (Fein, 1981). In the category of pretend play, investigators have used the terms imaginative play, make-believe play, fantasy play, dramatic play, symbolic play, and sociodramatic play (Fein, 1981; Stahmer, 1995; Thorp, Stahmer, & Schreibman, 1995). Additionally, definitions of the behaviors included in pretend play have ranged from the functional use of pretend play materials to role-playing around a theme such as doctor or house (Jung & Sainato, 2013; Lifter, Foster-Sanda, Arzamarski, Briesch, & McClure, 2011; Thorp *et al.,* 1995).

Pretend play is fairly advanced in most typically developing children by the age of two years and continues to develop into preschool and kindergarten (Fein, 1981; Lifter, Foster-Sanda, Arzamarski, Briesch, & McClure, 2011; Stahmer, 1995). In contrast, children diagnosed with autism spectrum disorder (ASD) often lack appropriate pretend play skills (Jarrold, 2003; Lang et al, 2009; Stahmer, 1995). Two of the most commonly used ASD screening and diagnostic

tools (i.e., The Autism Diagnostic Observation Schedule, Modified Checklist for Autism in Toddlers, Revised) include questions regarding pretend play skills or the absence thereof, indicating that it is significant for many children with ASD (Lord, Rutter, DiLavore, & Risi, 2002; Robins, Fein, & Barton, 2009). Additionally, studies have shown that children with ASD engage in less pretend play than children with other developmental disabilities, as well as typical peers (Jarrold, 2003; Rutherford & Rogers, 2003).

Researchers have used a variety of procedures to *teach pretend play skills* to children with ASD. These procedures include discrete trial teaching (DTT), pivotal response training (PRT), video modeling, and combinations of multiple procedures. DTT is most often used in one-on-one teaching contexts where distractions are kept to a minimum (Lovaas, 1981; Smith, 2001). DTT involves short sequences of formal teaching interactions made up of a discriminative stimulus, a prompt, the child's response, a consequence provided by the teacher, and an intertrial interval or pause before a new discriminative stimulus is *presented* (Smith, 2001). For example, to teach a child to pretend to cook, the teacher would begin with the presentation of a specific instruction (e.g., pretend to stir the soup). The teacher would then physically or verbally prompt the child to complete the action if needed and provide a reinforcer for the child's correct response. Some researchers have found that children may become dependent on prompts when DTT is the primary procedure used to teach play skills which can result in a lack of spontaneous pretend play behavior (Smith, 2001).

PRT was developed as a more naturalistic approach to teaching and includes child initiation, teacher models, task-related reinforcement for appropriate responses, and interspersed mastered tasks (Stahmer, 1995; Thorp *et al.,* 1995). For example, to teach a child to pretend to make soup, the teacher would first lay out appropriate play items and wait for the child to initiate

engagement with the items. The teacher would then play with the toys to model an appropriate play action. If the child does not engage or does not engage appropriately, the teacher would model the appropriate play action again (e.g., stirring a pot with a spoon) and re-present the play items to the child. If the child engaged in an appropriate play action the teacher would provide reinforcement in the form of an opportunity to play with other toys. Stahmer used PRT to teach pretend play to children with ASD and found that results regarding novel (i.e., untrained) play behaviors were inconsistent across participants. Although an average of 35% of participants' play behaviors following intervention were novel, responses varied greatly across participants, ranging from just 9% up to 56%. Further, participants were not able to generalize newly learned pretend play skills to play interactions with typical peers.

Video modeling has become widely used in recent years to teach children with ASD a variety of skills (Boudreau & D'Entrement, 2010; Charlop-Christy, Le, & Freeman, 2000; D'Ateno, Mangiapanello, & Taylor, 2003; MacDonald, Clark, Garrigan, & Vangala, 2005; Sani-Boskurt & Ozen, 2015). To use this procedure, teachers must first develop a video model that shows the target behavior or sequence of behaviors. The models may be adults (Boudreau & D'Entrement, 2010; Charlop-Christy et al., 2000; MacDonald et al., 2005), typical peers (Sani-Bozkurt & Ozen, 2015), or filmed from the perspective of the individual who is the target for intervention, thus showing an activity or task from the viewpoint of the child (Dupere, MacDonald, & Ahearn, 2013; Sancho, Sidener, Reeve, & Sidener, 2010). Models may be either familiar or unfamiliar to the participant (Sani-Bozkurt & Ozen, 2015). When used to teach pretend play, video modeling procedures generally involve one or more presentations of videos depicting sequences of play behaviors that children are typically expected to imitate (Dupere et al., 2013). One common limitation of video modeling studies that aim to teach children with

ASD to engage in appropriate pretend play is that participants do not often learn to engage in pretend play behaviors that are not explicitly modeled. For example, results from D'Ateno et. al. (2003) showed that participants did not increase their engagement in novel pretend play behaviors following a video modeling intervention, although pretend play behaviors demonstrated in the video model were performed successfully. In a review of the use of video models to teach play skills to children with ASD, Fragale (2014) found that play behaviors not modeled in the video rarely emerged as a result of intervention. Of the four studies reviewed that focused on solitary pretend play, none resulted in an increase in novel play behaviors. Fragale concluded that video modeling interventions for play currently do not adequately address the lack of variability seen in children with ASD and cited variability as an important area for future research.

Some intervention studies have investigated the combination of multiple procedures to teach pretend play skills. For example, Lalli, Zanolli, and Wohn (1994) used a combination of social reinforcement of a pretend play behavior and extinction of previously reinforced play behavior to increase novel play behaviors in two young children with developmental delays. After teaching one behavior with a particular toy, researchers provided social reinforcement for the first four occurrences of that play behavior and then placed the behavior on extinction. This sequence was repeated for each novel play behavior demonstrated by the child within each session and was successful in teaching pretend play to both children. Lang et al. (2014) used least-to-most prompting procedures (i.e., gesture, model, verbal, and physical prompts) and differential reinforcement in the form of social praise and small edibles to decrease repetition in pretend play behaviors and increase the likelihood of the generalization to novel toys for three children with ASD.

As the studies described above suggest, children with ASD often do not naturally vary their pretend play behavior, nor do they spontaneously engage in novel pretend play. Some comparative research has shown that children with ASD vary their pretend play behavior less than typically developing peers (Barton & Wolery, 2008; Lifter, Foster-Sanda, Arzamarski, Briesch, & McClure, 2011). This lack of variability is not surprising given that restricted and repetitive behavior is a common criterion used in the diagnosis ASD (American Psychiatric Association, 2013). A lack of variable and novel pretend play behavior may put children with ASD at a disadvantage for the following reasons. First, the absence of variability in pretend play may inhibit children with ASD from experiencing and engaging in new and different activities (Bancroft et al, 2016). For example, a preschool child may engage primarily with a toy tool set during playtime each day. If variability in play is increased we may discover that this child finds equal enjoyment in playing with a doctor set and continues to engage with it in the future, thus increasing his or her repertoire of play. Second, a lack of variable pretend play may limit opportunities to learn important skills such as social and communication skills (e.g., appropriately requesting to join peers in play; Bancroft et al, 2016). Third, repetitive behavior, particularly in play settings, may be seen as stigmatizing and can sometimes result in seclusion from peers, therefore limiting access to peer attention (Fein, 1981; Rodriguez & Thompson, 2015).

In the area of pretend play, variability refers to the occurrence of a variety of play behaviors in a pretend play setting that are not directly taught. Variability is often conceptualized as creativity. For example, Stahmer (1995) defined creative play as those play behaviors that were not directly taught during the training portion of the intervention. Eisenberger, Armeli, and Pretz (1998) described creativity as behavior that is original. In other words, creativity may be

used to refer to those behaviors that are novel to a particular play setting or those play behaviors that vary during a play session.

Promising research on variability and increasing variable and novel behaviors in non-human animals such as rats, pigeons, and porpoises has shown that variable responding can be increased with the use of lag schedules of reinforcement and differential reinforcement (Page & Neuringer, 1985; Pryor, Haag, & O'Reilly, 1969). Reinforcement during a lag schedule of reinforcement is delivered following a pre-specified number of responses that differ from previous responses (Lee & Sturmey, 2006). For example, if responses were reinforced on a lag 2 schedule of reinforcement, the organism would be provided with a reinforcer after engaging in a response that differed from the previous two responses, or a total of three different consecutive responses.

Similar procedures for increasing variability have been used to teach novel play in applied settings with typically developing children. In a study by Goetz and Baer (1973), researchers provided descriptive social reinforcement of block forms following the first appearance of a form in the experimental session. Researchers specified twenty block forms prior to the beginning of the study. Children's responses were scored based on these pre-specified block forms. The creation of block forms that had been seen previously within a particular session was not reinforced; rather, the creation of novel block forms was reinforced. All three participants increased the number of different block forms created in a session when novelty was directly reinforced. Cammilleri and Hanley (2005) used a combination of lag schedules and differential reinforcement to increase the number of novel classroom activities selected by two typically developing children. Activities included tasks such as computer-based math games, an opportunity to read a book, and playing with wooden blocks. Selections were considered novel if

they differed from all previous selections made in a particular session. Given that there were 12 opportunities for activity selection per session, the lag schedule of reinforcement gradually increased from one to 12 as the session progressed. Following the implementation of the lag schedule of reinforcement, both children increased the variability of their activity choices.

Variability and creativity are natural parts of play for most typically developing children, but, as previously stated, this is not often the case for children with ASD (Barton & Wolery, 2008; Lifter et al., 2011). Behavioral interventions explicitly targeting pretend play skills are often developed to make the play of children with ASD appear as similar as possible to that of typical children (Lang et al., 2014). The goal is that children with ASD can more easily interact with typically developing peers in an integrated setting. The pretend play of typically developing children often varies; therefore, it is important that researchers develop interventions that address not only appropriate pretend play behaviors but that also reduce repetition and increase variability in pretend play.

Although a number of studies have addressed appropriate pretend play in children with ASD, increasing variable responding in general is not often an initial target of intervention for children with ASD (Bancroft et al., 2016). There are, however, a few studies have attempted to explicitly increase variability or novelty in the pretend play of this population (Rodriguez &Thompson, 2015). Dupere et al., (2013) effectively used video models with substitutable loops to increase the variable pretend play responses of three five- and six-year-old children with ASD. In this study, researchers used video models to show appropriate sequences of pretend play. A substitutable loop was created by taking a portion of each video for each set of toys (i.e., boat, train, and zoo) and replacing this portion of the video during subsequent viewings with different examples of pretend play sequences such that children were exposed to multiple and varied

exemplars during training. Results showed that modeled pretend play actions increased for all three participants, but effects on the number of non-modeled (i.e., novel) play actions were inconsistent across participants following the video modeling intervention. In 2015, MacManus, MacDonald, and Ahearn taught pretend play to three verbal preschool-aged children with ASD using a video modeling and a matrix-training procedure that involved arranging a number of components to be presented that included all possible combinations of materials for each scenario. Using this procedure, a small number of play actions were trained. They found that pretend play actions that were modeled in the videos increased in all three participants. Additionally, two of the three participants also began exhibiting novel pretend play.

Newman, Reinecke, and Meinberg (2000) used specific verbal prompts and self-management techniques (i.e. self-administration of tokens) with three children with ASD to increase variability in a target behavior, one of which was pretend play for one child. One child in the study was in preschool and two were six years old; all three had the ability to speak in full sentences. The researchers taught different responses to each child; one child was taught to engage in pretend play. Researchers asked each child to vary his or her responding on the target behavior at the beginning of each discrete-trial session during all conditions, followed by ten opportunities to engage in a variable response. Responses were considered variable if they had not occurred previously in the session. Children were then taught to take a token independently and without adult prompts each time they engaged in a variable response, thus allowing them to monitor their own variation in responding. At the conclusion of each session, they could trade in their tokens for a variety of back-up reinforcers such as candy or computer time. All three children, including the child that was taught pretend play, showed an increase in response variability and were able to appropriately self-manage responding.

As briefly mentioned previously, Lang and colleagues (2014) used least-to-most prompting and differential reinforcement to teach three three-year-old children with ASD to increase engagement in pretend play behaviors with items such as a cooking set and a doctor set. All three participants displayed repetitive behavior with toys prior to intervention. During the first phase of intervention, children were taught to engage in appropriate play using least-to-most prompting and received social praise and a small edible for appropriate play behaviors. One child decreased repetitive play through this intervention alone. For the two children who did not display variability in pretend play in the first phase of intervention, a second phase of intervention was implemented. Following decreased repetitive play with a lag 1 schedule of reinforcement, teachers implemented a lag 2 schedule of reinforcement where reinforcement was provided for appropriate play behaviors that differed from the previous two play behaviors (i.e., reinforcement was provided following the consecutive performance of three different appropriate play behaviors). All lag requirements were based on responses within each session; therefore, behaviors did not have to be novel to the session to receive reinforcement but had only to meet the lag requirement based on preceding behavior(s). Results showed a decrease in repetitive toy play. Researchers did not include response variability as a dependent variable, thus it is unclear whether the variability of toy play increased.

Also briefly discussed above, Lalli et al., (1994) used a combination of extinction and differential reinforcement to increase appropriate novel toy engagement with airplanes, toy animals, and dolls with two children with developmental delays. Researchers provided descriptive praise following the first occurrence of a play behavior in a session. Reinforcement was presented on a fixed interval schedule of thirty seconds for three subsequent reinforcement opportunities at which point the initial play behavior was placed on extinction. This procedure

was repeated following the occurrence of each new play behavior in the session. The frequency of new play behaviors increased for both children when previous play behaviors were placed on extinction and reinforcement was provided for novel responses. Novel play behavior increased for both children.

Thorp et al., (1995) used PRT to teach pretend play to three elementary-aged boys with ASD. The type of pretend play taught in this study involved social interaction and role-playing with the experimenter and is, therefore, not considered solitary play. However, results of the study are still relevant to the current study. Although the researchers did not formally measure variability as an outcome of PRT, qualitative data indicated that two of their three participants began to engage in more variable play behaviors following training.

Napolitano and colleagues (2010) extended the previously mentioned work of Goetz and Baer by using a similar procedure with children with ASD between the ages of six and ten. The researchers used a lag 1 schedule of reinforcement in which every block building response that differed from the response that immediately preceded it was reinforced. The researchers in this study also utilized a direct verbal prompt by instructing children to "build differently" at the beginning of each trial (p. 267). Responses were not pre-specified, but the researchers determined that 23 different responses per session were possible based on the forms and colors of the blocks available. Therefore, there was a limit to the number of variations that children could display during each session. Results showed that variability in responding increased to some extent for all children following intervention, although four of the six children required direct teaching in addition to the implementation of a lag schedule of reinforcement to vary responding.

The purpose of the current study was to extend previous research on behavioral variability and novelty to more complex forms of pretend play with children with ASD. We used a similar procedure to those used by Goetz and Baer (1973) and Napolitano et al. (2010) to increase the variability and novelty of pretend play behaviors of three preschool-aged children with ASD. The current study targeted both variable pretend play behavior within each session and novel pretend play behavior across the study by using differential consequences. Variable play behavior was addressed by targeting engagement in different pretend play behaviors within each session. Novel play behavior was addressed by differentially reinforcing engagement in pretend play behaviors that had not occurred previously in any session in the study. Further, the study differed from the Goetz and Baer study in that response forms were not pre-specified or limited other than the requirement that responses fit within our definition of appropriate pretend play. Without a pre-specified list of responses, children's pretend play behaviors had the potential to be almost endlessly variable, thus allowing for more creativity to be recorded. The current study measured variability and novelty not only across participants, but also across three different pretend playsets and included materials.

Method

Participants

Three males diagnosed with ASD participated in the current study. Harry was seven years old during the study. Harry had the ability to speak in full sentences but rarely did so independently. Mack was six years old during the study. Mack had the ability to speak in full sentences, but his use of language was mostly limited to scripted statements and mands. Carl was three years old when the study began and four years old at the conclusion of the study. Carl independently spoke in full sentences. An independent professional diagnosed all children with ASD. All three children attended a university-based early intervention preschool for children

with ASD where they received 37.5 hours of one-to-one applied behavior analytic instruction each week.

Six weeks into data collection, Carl moved to an inclusive preschool classroom within the same university-based center. Harry and Mack remained in the same early intervention program throughout the course of the study. All children were recommended for the study based on parent and teacher reports that they exhibited deficits in pretend play skills and engaged in repetitive play behaviors.

Setting and Materials

Sessions were conducted in a research room in the center where the children attended preschool. A child-size table was present for every session. All other materials varied depending on the playset being targeted in a particular session. The playsets used in the present study were laundry, post office, and grill. A full list of the items included in each playset can be found in Appendix A. The primary researcher was present in the room during all baseline, intervention, and follow-up sessions. One trained observer was also present to videotape each session for later scoring.

Prior to the beginning of the study, parents completed a survey (Appendix B) in which we asked parents about pretend play items available at home and other commonly visited locations (e.g., grandparents' home), how often each child engaged with any available pretend play materials, and the different ways in which parents had observed their children engaging with pretend play items (e.g., played repetitively, made related sounds or comments, played with only one item in the playset). The parent surveys were used to aid toy selection such that exposure to pretend play items outside of research sessions could be avoided. Additionally, we used survey results to ensure that children were appropriate participants for our study. For

example, if parents indicated that their child engaged appropriately with all pretend playsets available at home, the child would not have been included in our study. Once parent surveys were completed, toys were selected from those owned by the preschool based on the children's lack of previous experience with each playset. Additionally, the primary researcher chose playsets with comparable numbers of play items available in each to allow for a similar number of response opportunities across playsets.

Once playsets and play items were chosen, the primary researcher conducted observations of typically developing preschool children during free play with the same items. These observations allowed the researcher to gather information on the number of different responses that could be expected with each playset and served as initial training sessions for trained observers. The primary researcher and observers recorded all of the different behaviors in which the children engaged with the playsets.

Dependent Measures

The four dependent variables evaluated in the present study were the number of different play behaviors displayed each session, the number of different play items used each session, the percentage of engagement in appropriate play during each session, and the cumulative number of novel play behaviors displayed over the course of the study.

Appropriate pretend play behavior was defined as any behavior in which the items included in the playset were used in a way that was consistent with the intended function of the items. The research team determined the types of behaviors that would be included in the definition of appropriate pretend play behavior through discussion and role play, but all final decisions regarding the inclusion of behaviors were made by the primary researcher. An appropriate pretend play behavior was considered variable if it had not occurred previously

within a given session. An appropriate pretend play behavior was considered novel if it had not occurred previously in any session in the study. (Operational definitions can be found in Appendix C.)

Data Collection

All sessions were five minutes in duration and occurred between two and six times per week for each child. Sessions occasionally occurred multiple times per day depending on each child's individual schedule. The order of playset presentation was randomized using a random number generator. The primary researcher recorded data following the session while viewing videos. The researcher recorded each individual appropriate pretend play behavior and scored the frequency of each behavior in 15-second intervals using paper and pencil data sheets. The researcher also used whole interval scoring to record intervals in which no response occurred and in which no targeted response occurred. No response was recorded if the child was not engaged in appropriate play behavior and was not in contact with any items included in the playset for the entire 15-second interval. No targeted response also was recorded if the child engaged with the playset or play items in a way that was inconsistent with their intended function, or if the child was otherwise inappropriately engaging with the play items (e.g., using a play item to engage in stereotypic behavior) for the entire 15-second interval (Appendix C).

Interobserver Agreement and Treatment Integrity

A second observer was trained to score research sessions using a sample of videotaped sessions. These sessions were used for training only and are not included in final calculations of interobserver agreement. The primary researcher and trained observer scored all videos independent of one another. Interobserver agreement (IOA) was calculated using proportional agreement. Agreement was calculated for each interval by dividing the smaller frequency

recorded by one observer by the larger frequency recorded by the other observer. These interval quotients were then added together, divided by the total number of intervals in the session, and multiplied by 100 to get the percentage of agreement for each session.

Tables 1-3 summarize the reliability results for each playset and phase of the study for Harry, Mack, and Carl, respectively. A trained observer scored reliability for 38.17% of baseline sessions for Harry across all three playsets. Mean IOA for Harry for laundry was 96.75% (range, 95%-99%), for post office was 97.62% (range, 95%-98.89%), and for grill was 97.26% (range, 94.6%-98.8%). A trained observer scored reliability for 35.88% of baseline sessions for Mack across the laundry and post office playsets. Mack moved prior to receiving intervention with grill and we will therefore not present reliability data for Mack with grill. Mean IOA for Mack for laundry was 96.55% (range, 90.4%-100%), and for post office was 93.37% (range, 80%-99.17%). A trained observer scored reliability for 35.16% of baseline sessions for Carl across all three playsets. Mean IOA for Carl for laundry was 96.13% (range, 93.6%-98.64%), for post office was 97.18% (range, 94.72%-99.15%), and for grill was 97.04% (range, 91.87%-99.07%).

A trained observer scored reliability for 36.68% of intervention sessions for Harry across all three playsets. Mean IOA for Harry for laundry was 96.75% (range, 92.73%-100%), for post office was 98.07% (range, 96.67%-99.35%), and for grill was 97.62% (range, 96.05%-98.47%). A trained observer scored reliability for 37.39% of intervention sessions for Mack across the laundry and post office playsets. Mean IOA for Mack for laundry was 98.22% (range, 96.88%-99%), and for post office was 98.92% (range, 98.52%-99.77%). A trained observer scored reliability for 37.5% of intervention sessions for Carl across all three playsets. Mean IOA for Carl for laundry was 98.53% (range, 95.91%-99.38%), for post office was 99.13% (range, 98.53%-100%), and for grill was 99.25% (range, 98.33%-100%).

A trained observer scored reliability for 41.11%% of maintenance sessions for Harry across all three playsets. Mean IOA for Harry for laundry was 98.51% (range, 98.22%-99%), for post office was 98.85%, and for grill was 98.82% (range, 98.61%-99%). A trained observer scored reliability for 100% of maintenance sessions for Mack across the laundry and post office playsets. IOA for Mack for laundry was 99.41% and for post office was 95.29%. A trained observer scored reliability for 50% of maintenance sessions for Carl for the laundry and post office playsets. Mean IOA for Carl for laundry was 99.43% (range, 99.09%-99.77%), and for post office was 100%. Carl left the preschool before the researcher was able to conduct maintenance sessions with grill.

Tables 4-6 summarize the treatment integrity results for each playset and phase of the study following baseline for Harry, Mack, and Carl, respectively. The observer scored the type of behavior (i.e., first occurrence in session, has already occurred in session, first occurrence in study), whether praise was or was not given by the primary researcher, the primary researcher's subsequent statement (i.e., description of behavior, description of behavior plus a statement of different, description of behavior plus a statement of novelty), and whether an edible was or was not provided following the behavior. One point was available for each behavior based on the extent to which the primary researcher responded in accordance with the intervention as designed. The total number of points earned was then divided by the total number of points available for the session and multiplied by 100 to obtain a percentage for TI.

The trained observer scored TI for 36.68% of intervention sessions for Harry. Mean TI for Harry for laundry was 91.88% (range, 83.33%-100%), for post office was 96.48% (range, 94.74%-98.63%), and for grill was 95.93% (range, 91.54%-98.97%). The trained observer scored TI for 36.67% of intervention sessions for Mack. Mean TI for Mack for laundry was

96.97%, range, 86.67%-100%), and for post office was 99.68% (range, 98.72%-100%). The trained observer scored TI for 37.5% of intervention sessions for Carl. Mean TI for Carl for laundry was 99.56% (range, 97.33%-100%), for post office was 98.84% (range, 96.96%-100%), and for grill was 100%.

The trained observer scored TI for 47.78% of maintenance sessions for Harry. Mean TI for Harry for laundry was 92.88% (range, 90%-95.76%), for post office was 98.59% (range, 97.17%-100%), and for grill was 100%. The trained observer scored TI for 100% of maintenance sessions for Mack across the laundry and post office playsets. All TI scores were 100%. The trained observer scored TI for 50% of maintenance sessions for Carl. Mean TI for Carl for laundry was 99.08% (range, 98.15%-100%), and for post office was 100%.

Design

The current study used two multiple baseline designs which were run concurrently throughout the study: a multiple baseline design across playsets and a multiple baseline design across children. We chose to use two multiple baseline designs to protect against the possibility that generalization might occur across playsets once the intervention was introduced to each child. Generalization across playsets, although ideal, would weaken experimental control; therefore, we chose to use two multiple baseline designs implemented concurrently so that we could still demonstrate experimental control should generalization occur.

Procedure

General procedure. All sessions were conducted in a partitioned area of a classroom at a university-based preschool when no other children were present in the classroom. The primary researcher conducted all sessions across all phases of the study. A research assistant was also present to videotape each session for later scoring. The primary researcher began each session

with the same instruction to “Go play with the [playset] toys, please.” No additional rules, instructions, or prompts were provided prior to or during any session in the study.

Baseline. During baseline each child was brought into the room where one of three playsets was set up. The primary researcher then instructed the child to “Go play with the [playset] toys, please.” The child was given five minutes to engage with the various items included in the playset. Each playset included between sixteen and nineteen items. No reinforcement or feedback was provided for any behavior during baseline. Any attempts by the child to interact with the researcher were ignored during this phase. Upon completion of each session, the researcher told the child that he was all done and that they would now walk back to his classroom.

Intervention. The primary researcher conducted a paired stimulus preference assessment (Fisher et al., 1992) with each child prior to the beginning of the study to develop a hierarchy of edible preferences for each child. Edible items used in the preference assessment were reported by each child’s teacher to be items that he reliably consumed and appeared to enjoy. Each child’s top three preferred edible items were then presented against one another prior to the start of each intervention session. The researcher used social praise and an edible reinforcer (rather than a tangible reinforcer that the child could play with) in an attempt to reduce the interruption of the ongoing pretend play action as much as possible. Edible reinforcers were cut into small pieces to avoid satiation.

The three different pretend playsets were presented to each child in the same order (i.e., laundry, post office, and grill). During intervention sessions, the primary researcher, one researcher assistant, and one child were in a room with the materials for one playset. The researcher gave the child an instruction to “Go play with the [playset] toys, please." The

researcher provided reinforcement for each appropriate pretend play behavior in which the child engaged during the session. If the child engaged in a play behavior for the first time in a given session, but the behavior had occurred in a previous session, the researcher provided descriptive social praise (e.g., "Awesome! You picked up the iron!), a statement indicating that that the child did something different (i.e., "That's different!), and one piece of a preferred edible. A list of all appropriate pretend play behaviors previously performed over the course of the study was compiled for each child. Each list was used during the sessions to aid in the identification of within session behaviors as variable, novel, or not novel to ensure that the researcher responded appropriately to each behavior. If the child engaged in a pretend play behavior that had already occurred within the session, the researcher provided descriptive social praise (e.g., "Excellent! You picked up the calculator!"). If the child engaged in novel pretend play behavior that had not occurred previously in the study (including baseline sessions), the researcher provided descriptive social praise (e.g., "Wow! You ironed the shirt!), a statement about novelty (i.e., "I've never seen you do that before!"), and three pieces of a preferred edible. Upon completion of each session, the researcher told the child that he was all done playing and that they would now walk back to his classroom.

The research team used visual analysis to determine the point at which the intervention was introduced with each child and for each playset. The intervention was initially introduced with the first child when behavior with playset A (i.e., laundry) in the baseline condition was stable or decreasing. In the baseline condition, stability was defined as three consecutive sessions with no change in trend (i.e., three consecutive data points with the same y-value) across all dependent variables (i.e., different pretend play behaviors per session, different play items used each session, engagement in appropriate pretend play, and cumulative pretend play behaviors).

In the intervention condition, stability was defined as three sessions with no change in trend or minimal change in trend (i.e., no more than an increase of three behaviors) across all dependent variables with the target playset. Once the pretend play behavior displayed by the first child began to increase across consecutive sessions with playset A, the intervention was introduced with playset B (i.e., post office). At the same time, the research team examined the performance of the second child with playset A in the baseline condition. If the second child's behavior with playset A was stable or decreasing at the same time that the first child's behavior with playset A was increasing, we implemented the intervention procedure with the second child with playset A. If the second child's behavior with playset A was increasing, we waited to intervene until the second child's behavior was stable or decreasing with playset A. Once the second child showed an increasing trend with playset A following intervention and the third child showed a stable or decreasing trend with playset A, the intervention was introduced with playset A with the third child. The intervention was implemented in this way across the three playsets for each child in the same order. Decisions regarding changing conditions were made based on the number of different behaviors seen per session and the percentage of engagement per session and were based on performance both across playsets and across children.

Maintenance. Maintenance sessions were conducted periodically following the end of intervention to determine the durability of the effects of the intervention on the variable and novel pretend play behaviors of each child. Maintenance sessions were identical to intervention sessions.

Results

Figure 1 displays data for the laundry playset across participants. Tables 7-9 summarize the overall within session means for each phase of the study for the number of items used per

session, the number of different behaviors per session, and the percentage of engagement in appropriate play per session for each playset for Harry, Mack and Carl, respectively. Harry engaged in an average of 1.86 behaviors per session and used an average of 1.33 items per session during baseline. Following intervention, the number of different pretend play behaviors in which Harry engaged each session increased to an average of 13.47 and the number of different items used increased to an average of 7.37. These increases maintained for up to nine weeks post-intervention.

Mack engaged in an average of 8.41 behaviors per session and used an average of 5.82 items per session during baseline with the laundry playset. Following intervention, the number of different pretend play behaviors in which Mack engaged each session increased to an average of 14.09 and the number of different items used increased to an average of 10.35. These increases maintained at one week post-intervention.

Carl engaged in an average of 10.04 behaviors per session and used an average of 5.42 items per session during baseline with the laundry playset. Following intervention, the number of different pretend play behaviors in which Carl engaged each session increased to an average of 16 and the number of different items used increased to an average of 10.44. The number of different pretend play behaviors in which Carl engaged and the items used each session averaged 12 and 10.5, respectively, during maintenance sessions for up to 13 weeks post-intervention.

Figure 2 displays data for the post office playset across participants. Harry engaged in an average of 5.35 behaviors per session and used an average of 3.76 items per session during baseline with the post office playset. (Table 7). Following intervention, the number of different pretend play behaviors in which Harry engaged each session increased to an average of 26.57 and the number of different items used each session increased to an average of 14.86. The

number of different pretend play behaviors in which Harry engaged each session maintained for up to seven weeks post-intervention.

Mack engaged in an average of 3.91 behaviors per session and used an average of 3.23 items per session during baseline with the post office playset (Table 8). Following intervention, the number of different pretend play behaviors in which Mack engaged each session increased to an average of 15 per session and the number of different items used each session increased to an average of 14.3 per session. The number of different pretend play behaviors and items used each session maintained for three weeks post-intervention.

Carl engaged in an average of 7.39 behaviors per session and used an average of 4.81 items per session during baseline with the post office playset (Table 9). Following intervention, the number of different pretend play behaviors in which Carl engaged each session increased to an average of 15.25 per session and the number of different items used each session increased to an average of 12.38 per session. The number of different behaviors and items used per session decreased slightly during maintenance sessions for up to 8 weeks post-intervention but remained above baseline levels.

Figure 3 displays data for the grill playset across Harry and Carl; Mack moved prior to receiving intervention with the grill playset. Harry engaged in an average of 17.18 behaviors per session and used an average of 10.18 items per session during baseline with the grill playset (Table 7). These data are higher than Harry's baseline data with both the laundry and post office playsets. Following intervention, the number of different pretend play behaviors in which Harry engaged increased further to an average of 36.25 per session and the number of different items used each sessions increased to an average of 18.19 per session. The number of different items

used per session maintained and the number of different behaviors he engaged in per session increased during maintenance sessions for up to nine weeks post-intervention.

Carl engaged in an average of 19.97 different behaviors per session and used an average of 11 items during baseline with the grill playset (Table 9). Following intervention, the number of different pretend play behaviors in which Carl engaged each session decreased to an average of 11.5 per session and the number of items used each sessions increased slightly to an average of 11.38 per session.

Overall, these data show that intervention was effective in changing the behavior of all three participants. Specifically, there were increases in the number of different appropriate pretend play behaviors per session and the number of different play items used per session following the implementation of the intervention with the exception of the grill playset for Carl.

Figure 4 displays the percentage of intervals engaged in appropriate pretend play each session with the laundry playset across participants. Engagement displayed by Harry increased from an average of 5.71% per session in baseline to 56.58% per session during intervention (Table 7). Engagement maintained and reached 100% (M = 97.5%) for up to seven weeks post-intervention. Engagement displayed by Mack with the laundry playset increased from an average of 48.82% per session in baseline to 70.87% per session following intervention (Table 8). Engagement decreased slightly during a maintenance session conducted one week following the end of intervention but remained above baseline levels. Engagement displayed by Carl with the laundry playset increased from an average of 54.58% per session in baseline to 78.44% per session following intervention (Table 9). Engagement decreased to baseline levels during maintenance sessions.

Figure 5 displays the percentage of intervals engaged in appropriate pretend play per session with the post office playset across participants. Engagement displayed by Harry with the post office playset increased from an average of 36.82% per session in baseline to 95.36% per session immediately intervention (Table 7). Engagement maintained for up to seven weeks post-intervention. Engagement displayed by Mack with the post office playset increased from an average of 29.55% per session in baseline to 53% per session following intervention (Table 8). Engagement maintained and increased slightly during a maintenance session conducted on week following the end of intervention. Engagement displayed by Carl with the post office playset increased from an average of 45.97% per session in baseline to 68.13% per session following intervention (Table 9). Engagement maintained for up to 8 weeks post-intervention.

Figure 6 displays the percentage of intervals engaged in appropriate pretend play per session with the grill playset across Harry and Carl. Mack moved prior to receiving intervention with the grill playset. Engagement displayed by Harry increased from an average of 52.95% per session in baseline to 99.38% per session immediately following intervention (Table 7). Engagement maintained at 100% for up to three weeks post-intervention. Engagement displayed by Carl with the grill playset decreased from an average of 64.62% per session in baseline to 58.13% per session following intervention (Table 9).

Overall, these data show that intervention was effective in increasing engagement in appropriate pretend play for all participants across all three playsets with the exception of Carl with the grill playset. The amount of behavior change varied across children.

Figure 7 displays a cumulative record of the number of novel pretend play behaviors recorded with the laundry playset during the study across participants. The number of novel pretend play behaviors increased rapidly beginning at intervention session 11. Harry engaged in

one novel pretend play behavior during maintenance. Novel pretend play behavior displayed by Mack and Carl did not appear to change following intervention.

Figure 8 displays a cumulative record of the number of novel pretend play behaviors recorded with the post office playset during the study across participants. The number of novel pretend play behaviors displayed by Harry increased rapidly immediately following the implementation of intervention. He engaged in at least one novel pretend play behavior during each maintenance session for up to seven weeks. Mack engaged in novel pretend play behavior during the first two intervention sessions, but his pretend play behavior plateaued thereafter. Carl continued to engage in novel pretend play behavior following intervention.

Figure 9 displays a cumulative record of the number of novel pretend play behaviors recorded with the grill playset during the study across Harry and Carl. Mack moved before receiving intervention with the grill playset. The number of novel pretend play behaviors displayed by Harry steadily increased during intervention. Carl did not engage in any novel pretend play behavior following intervention.

Overall, these data indicate that intervention was most effective in increasing novel pretend play behavior for Harry. Although both Mack and Carl engaged in some novel pretend play behavior during intervention, there was much change as compared to baseline.

Figure 10 displays data for Harry across all three playsets. Harry engaged in an average of 1.86 different pretend play behaviors and used an average of 1.33 items per session during baseline with the laundry playset. Following intervention, the number of different pretend play behaviors in which Harry engaged each session increased to an average of 13.47 and the number of different items used increased to and average of 7.37. These results maintained for up to nine weeks post-intervention. Harry engaged in an average of 5.35 pretend play behaviors per session

and used an average of 3.76 items per session during baseline with the post office playset. Following intervention, the number of different pretend play behaviors in which Harry engaged each session increased to an average of 26.57 and the number of different items used increased to an average of 14.86. These results maintained for up to seven weeks post-intervention. Harry engaged in an average of 17.18 pretend play behaviors per session and used an average of 10.18 items per session during baseline with the grill playset. Following intervention, the number of different pretend behaviors in which Harry engaged each session increased to an average of 36.25 and the number of different items used increased to an average of 18.19. These results maintained for up to nine weeks post-intervention.

Figure 11 depicts the percentage of intervals in which Harry was engaged in appropriate pretend play during each session across all three playsets. Engagement with the laundry playset increased from an average of 5.71% per session in baseline to 58.68% per session following intervention. These results maintained and reached 100% for up to seven weeks post-intervention with an average of 97.5%. Engagement with the post office playset increased from an average of 36.82% per session in baseline to 95.36% per session immediately following intervention. These results maintained for up to seven weeks post-intervention. Engagement with the grill playset increased from an average of 52.95% in baseline to 99.38% immediately following intervention. These results maintained at 100% for up to three weeks post-intervention.

Figure 12 displays a cumulative record of the number of novel pretend play behaviors recorded for Harry across all three playsets. The number of novel pretend play behaviors in which Harry engaged with the laundry playset increased rapidly beginning at intervention session 11. He engaged in one novel pretend play behavior during maintenance sessions. The number of novel pretend play behaviors in which Harry engaged with the post office playset

increased rapidly immediately following the implementation of the intervention. He engaged in at least one novel pretend play behavior during each maintenance session for up to seven weeks. The number of novel pretend play behaviors in which Harry engaged with the grill playset increased steadily following the implementation of the intervention.

Our intervention appeared to be very effective for Harry. We saw increases in all dependent variables across all playsets with Harry (Table 7).

Figure 13 contains data for across all the laundry and post office playsets. Mack moved before receiving intervention with grill. Mack engaged in an average of 8.41 behaviors per session and used an average of 5.82 items per session during baseline with the laundry playset. Following intervention, there were increases in the number of different pretend play behaviors in which Mack engaged each session to an average of 14.09 and an increase in the number of different items used to an average of 10.35 with the laundry playset. These results maintained one week post-intervention. Mack engaged in an average of 3.91 behaviors per session with the post office playset and used an average of 3.23 items per session during baseline. Following intervention, there were increases in the number of different pretend play behaviors in which Mack engaged each session to an average of 15 and an increase in the number of different items used to an average of 14.3 with the post office playset. These results maintained for three weeks post-intervention.

Figure 14 depicts the percentage of intervals in which Mack was engaged in appropriate pretend play per session across the laundry and post office playsets. Engagement with the laundry playset increased from an average of 48.82% per session in baseline to 70.87% per session following intervention. Engagement decreased slightly one-week following the end of intervention but remained above baseline levels. With the post office playset, engagement

increased from an average of 29.55% per session in baseline to an average of 53% per session following intervention. These results maintained and increased slightly one-week following the end of intervention.

Figure 15 displays a cumulative record of the number of novel pretend play behaviors recorded for Mack across the laundry and post office playsets. Novel laundry pretend play behaviors in which Mack engaged did not appear to change following intervention. With the post office playset, Mack engaged in novel pretend play behavior during the first two intervention sessions, but his behavior plateaued thereafter.

Our intervention was effective in changing some of Mack's behavior but less effective with others. We saw the biggest changes following intervention with Mack in the number of different pretend play behaviors per sessions, the number of different items used per session, and the percentage of engagement in appropriate pretend play per session for both playsets. We also saw increases in the overall consistency of his responding following intervention. However, we did not see much change in overall cumulative data for Mack as a result of the intervention.

Figure 16 displays data for Carl across all the three playsets. With the laundry playset, Carl engaged in an average of 10.04 behaviors per session and used an average of 5.42 items per session during baseline. Following intervention, there were increases in the number of different pretend play behaviors in which Carl engaged in each session to an average of 16 and an increase in the number of different items used to an average of 10.44 with the laundry playset. The number of different behaviors and items used per session decreased slightly during maintenance sessions run for 13 weeks post-intervention but remained above baseline levels. With the post office playset, Carl engaged in an average of 7.39 behaviors per session and used an average of 4.81 items per session during baseline. Following intervention, there were increases in the

number of different pretend play behaviors in which Carl engaged each session to an average of 15.25 and an increase in the number of different items he used to an average of 12.38 with the post office playset. These results were seen to decrease slightly but still remained above baseline levels during maintenance sessions for up to 8 weeks post-intervention. With the grill playset, Carl engaged in an average of 19.97 behaviors per session and used an average of 11 items per session during baseline. Following intervention, there was a decrease in the number of different pretend play behaviors in which Carl engaged each session to an average of 11.5 and a very slight increase in the number of different items used each session to an average of 11.38 with the grill playset.

Figure 17 depicts the percentage of intervals in which Carl engaged in appropriate pretend play per session across all three playsets. Engagement with the laundry playset increased from an average of 54.58% per session in baseline to 78.44% per session following intervention. Engagement decreased to baseline levels with laundry during maintenance sessions. Engagement with the post office playset increased from an average of 45.97% per session in baseline to 68.13% per session following intervention. These results maintained during follow-up for up to 8 weeks post-intervention. Engagement with the grill playset decreased from an average of 64.62% per session in baseline to 58.13% following intervention.

Figure 18 displays a cumulative record of the number of novel pretend play behaviors recorded for Carl across all three playsets. The novel laundry pretend play behaviors in which Carl engaged did not appear to change following intervention. Carl continued to engage in novel post office pretend play behavior following intervention but did not engage in any novel grill pretend play behavior following intervention.

We saw mixed results of intervention effectiveness with Carl. Results indicate that our intervention was effective in increasing the variability of pretend play behavior in which Carl engaged each session and the percentage of engagement in appropriate pretend play each session with the laundry and post office playsets. However, we saw the opposite effect with the grill playset. Additionally, we did not see much change in Carl's overall cumulative data as a result of the intervention.

Discussion

The primary purpose of the current study was to increase the number of variable and novel pretend play behaviors displayed by three children with ASD using differential reinforcement. Previous basic and applied behavior analytic research has shown that variable responding can be controlled by environmental contingencies such as reinforcement. This same effect was demonstrated in the present study. We were successful in using differential reinforcement to increase variable pretend play behavior of three children with ASD with three different pretend playsets. Additionally, we saw an increase in the percentage of engagement in appropriate pretend play following the implementation of the differential reinforcement intervention. Results for cumulative measures of novel pretend play behaviors across the study were mixed. As previously mentioned, the present study extended the previous literature on variability and novelty to more complex play behaviors of children with ASD. Additionally, we demonstrated that behavioral effects on variability could be seen in the absence of instructions, prompts, or the explicit training of particular behaviors.

Although our study was effective in increasing variable pretend play behavior, there were a few limitations that warrant further discussion. First, preferred edibles may not have been the most potent reinforcer for all three children as evidenced by varying levels of behavior change

across children. These differences may have been due to individual preference or satiation. Access to preferred edible snacks outside of research sessions may have lead some children to become satiated and therefore less motivated to earn preferred edibles during the session. Future researchers may explore other types of reinforcement or consider using tokens so ensure that all children have access to a highly preferred reinforcer.

Second, it is possible that the difference in reinforcer magnitude for variable versus novel pretend play behavior (i.e., one piece of edible versus three pieces of edible, respectively) within each session was not discernible by all children. Pieces of preferred edibles used in the study were also rather small to avoid satiation during the session. For example, one sour patch kid was cut into four separate pieces. These small quantities of edibles may have made the difference in magnitude difficult to distinguish. Future research might examine the minimum difference in edible reinforcer magnitude required for children to respond in ways that are consistent with the reinforcement contingencies.

Third, the brief sessions may not have allowed for enough time to engage in novel behavior in some cases. For example, Carl took more time to consume preferred edibles, which may have given him less opportunity to engage in pretend play behavior in general. If Carl took five minutes to engage only in the behaviors he had performed in previous sessions, he would not have had the opportunity to access reinforcement for novel behavior simply due to time constraints. Lengthening sessions to ten minutes rather than five, for example, may increase the likelihood of engaging in novel behavior in such cases. Future researchers may also consider removing edible consumption time from the overall session time to ensure that the time available for engaging in pretend play behavior remains constant across all sessions.

Fourth, we did not control for the inclusion of adult attention in the intervention and maintenance phases. No adult attention was provided during baseline. However, adult attention was provided in the form of social praise and behavior-specific statements during both intervention and maintenance phases. Future researchers should consider including non-contingent adult attention on a time-based schedule during baseline to ensure the consistency of adult attention across all phases of the study.

Fifth, we were unsuccessful in increasing Carl's variable and novel pretend play behavior with the grill pretend playset following intervention. We have several hypotheses as to why this may have occurred. Carl's baseline number of variable and novel pretend play behaviors with grill was higher than his baselines with the other two playsets and was comparable to normative data collected with typically developing preschool children. It is possible that we did not see an increase because Carl had already achieved his maximum rate of pretend play behaviors within a five-minute session.

Additionally, it is possible that, given Carl's verbal repertoire, a simple statement of the contingency may have been successful in increasing his variable and novel pretend play behavior. Other children may also have responded differently had the contingencies been directly stated, although all three children had slightly different verbal repertoires and general skill sets. Because no instructions were given at any time, it is possible that some children did not understand the different responses required for reinforcement. Some children may have increased their variable and novel responding further had a rule been presented either at the beginning of the session or throughout. Previous studies have included instructions to vary behavior (e.g., Newman, et. al., 2000), but given that they were presented as part of an intervention the individual effects of rule statements on variable and novel responding were unclear. Future

research should explore the effects of rules or direct statements of the contingencies on variable and novel pretend play behavior of children with ASD with different verbal repertoires.

Sixth, some behaviors that did not fall under the definition of "appropriate pretend play behavior" may have been inadvertently reinforced. Specifically with Harry, there were times when he was engaging in different pretend play behaviors so quickly that it was impossible for the researcher to provide a reinforcer immediately following one behavior but before he began engaging in another behavior. There were likely times, therefore, when the reinforcer was provided immediately following an inappropriate behavior (e.g., putting the ketchup bottle in the cup). Although this did not seem to affect Harry's overall appropriate play responses, one solution may be the addition of a time delay between the completion of an inappropriate play behavior and the presentation of the preferred edible.

Finally, we saw higher order stereotypy with some children over the course of the study. Higher order stereotype refers to larger patterns of responding that emerge during research sessions. Such larger response patterns occurred with some children. For example, with the post office playset, Mack consistently engaged with the play materials in the same order at the beginning of each session. Higher order stereotypy could be addressed by the inclusion of a lag schedule of reinforcement or a condition that requires that the overall sequence of behaviors seen in each session differ in order from the previous session.

Given the paucity of research on variable and novel responding in children with ASD, there are many possibilities for future research in this area; we present a few possibilities here. First, although the purpose of the present study was not to evaluate the generalization of pretend play skills to the natural environment, we observed two of the three children included in the study during free play periods in an inclusive preschool setting. Various play materials were

available during each free play period, including one playset used in the study (i.e., laundry, post office, or grill). Other materials, including toy cars, drawing materials, painting materials, dollhouses, action figures, and marble run building materials, were set up either at one of the four tables in the classroom or on the floor in a carpeted area of the room. The number of typically developing peers in the classroom ranged from ten to fifteen during these times. The other children in the room were free to play with any items they chose, including the research playsets. One child who participated in our study engaged in more appropriate pretend play with the research playsets during free play following intervention than prior to intervention. However, overall we did not observe an increase in variable pretend play skills in the natural environment following our intervention. Two of the children in the study engaged with other available toys during this period, but they did not always engage with the playsets used in the research sessions. Future researchers should program for the generalization of variable pretend play skills outside of the research environment. One way to program for generalization may be to fade typically developing peers into the research setting and then slowly transition to the classroom setting. Researchers could also consider systematically fading reinforcement to make the research setting more similar to the natural environment. Future researchers should address these and other ways to program for the generalization of variable and novel pretend play skills to the natural environment.

Second, we did not test for generalization to new pretend playsets. However, we did not see generalization of variable and novel responding to other playsets across children once the intervention was introduced with the first playset. However, this warrants further investigation.

Third, although the present study was successful in increasing the variable and novel pretend play of children with ASD, not all children began engaging in appropriate play

sequences over the course of the study. It may be necessary to shape new responses into more natural play sequences.

Finally, although the primary researcher collected some data during observations of typically developing children engaging in pretend play, future researchers should develop systematic ways of collecting normative data in various contexts. Increasing variable and novel responding is important in many settings, and it is important to have normative data for comparison and to guide mastery criteria and terminal goals. Additionally, normative data would provide more information on when variable responding is and is not appropriate in a typical classroom setting. This would allow researchers and clinicians to teach children with ASD to engage in variable and novel behavior and to discriminate when variability and novelty are and are not appropriate.

Overall, the results of the present study show that variable pretend play behavior can be controlled through reinforcement contingencies. These results are consistent with both basic and applied research on variable responding. Although further research is needed in this area, we think that this research provides a starting point for using differential reinforcement to teach children with ASD to engage in variable and novel pretend play behavior.

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Table 1

Reliability Results for Harry

	Laundry	Post Office	Grill
Baseline			
Percentage of Sessions Scored	42.86%	35.29%	36.36%
Percentage of Interobserver Agreement	**96.75%**	**97.62%**	**97.26%**
Intervention			
Percentage of Sessions Scored	36.84%	35.71%	37.50%
Percentage of Interobserver Agreement	**96.75%**	**98.07%**	**97.62%**
Maintenance			
Percentage of Sessions Scored	33.33%	40.00%	50.00%
Percentage of Interobserver Agreement	**98.51%**	**98.82%**	**98.85%**

Table 2

Reliability Results for Mack

	Laundry	Post Office
Baseline		
Percentage of Sessions Scored	35.29%	36.36%
Percentage of Interobserver Agreement	**96.55%**	**93.37%**
Intervention		
Percentage of Sessions Scored	34.78%	40.00%
Percentage of Interobserver Agreement	**98.22%**	**98.92%**
Maintenance		
Percentage of Sessions Scored	100.00%	100.00%
Percentage of Interobserver Agreement	**99.41%**	**95.29%**

Table 3
Reliability Results for Carl

	Laundry	Post Office	Grill
Baseline			
Percentage of Sessions Scored	33.33%	35.48%	36.67%
Percentage of Interobserver Agreement	**96.13%**	**97.18%**	**97.31%**
Intervention			
Percentage of Sessions Scored	37.50%	37.50%	37.50%
Percentage of Interobserver Agreement	**98.53%**	**99.13%**	**99.25%**
Maintenance			
Percentage of Sessions Scored	50.00%	50.00%	*n/a*
Percentage of Interobserver Agreement	**99.43%**	**100.00%**	*n/a*

Table 4
Treatment Integrity Results for Harry

	Laundry	Post Office	Grill
Intervention			
Percentage of Sessions Scored	36.84%	35.71%	37.50%
Mean	**91.88%**	**96.48%**	**95.93%**
Maintenance			
Percentage of Sessions Scored	33.33%	60.00%	50.00%
Mean	**92.88%**	**98.59%**	**100.00%**

Table 5

Treatment Integrity Results for Mack

	Laundry	Post Office
Intervention		
Percentage of Intervention Sessions Scored	36.84%	40.00%
Mean	**91.88%**	**99.68%**
Maintenance		
Percentage of Sessions Scored	100.00%	100.00%
Mean	**100.00%**	**100.00%**

Table 6

Treatment Integrity Results for Carl

	Laundry	Post Office	Grill
Intervention			
Percentage of Sessions Scored	37.50%	37.50%	37.50%
Mean	**99.56%**	**98.84%**	**100.00%**
Maintenance			
Percentage of Follow-up Sessions Scored	50.00%	50.00%	*n/a*
Mean	**99.08%**	**100.00%**	*n/a*

Table 7

Within Session Means for Harry

	Baseline	Intervention	Maintenance
Laundry			
n	6	13	6
Items	1.50	7.37	15.50
Behaviors	2.17	13.47	32.00
Engagement (%)	6.67	58.68	97.50
Post Office			
n	16	14	5
Items	3.88	14.86	15.80
Behaviors	5.50	26.57	33.40
Engagement (%)	32.81	95.36	99.00
Grill			
n	21	16	2
Items	10.67	18.19	18.50
Behaviors	18.00	36.25	43.50
Engagement (%)	55.48	99.38	100.00

Table 8
Within Session Means for Mack

	Baseline	Intervention	Maintenance
Laundry			
n	16	23	1
Items	6.19	10.35	11.00
Behaviors	8.94	14.09	19.00
Engagement (%)	46.56	70.87	70.00
Post Office			
n	21	10	1
Items	3.38	14.30	15.00
Behaviors	4.10	15.00	16.00
Engagement (%)	30.95	53.00	75.00

Table 9
Within Session Means for Carl

	Baseline	Intervention	Maintenance
Laundry			
n	23	16	4
Items	5.65	10.44	10.50
Behaviors	10.48	16.00	12.00
Engagement (%)	56.96	78.44	55.00
Post Office			
n	30	16	4
Items	4.97	12.38	11.50
Behaviors	7.63	15.25	14.00
Engagement (%)	47.50	68.13	63.75
Grill			
n	38	8	*n/a*
Items	11.29	11.38	*n/a*
Behaviors	20.50	11.50	*n/a*
Engagement (%)	66.32	58.13	*n/a*

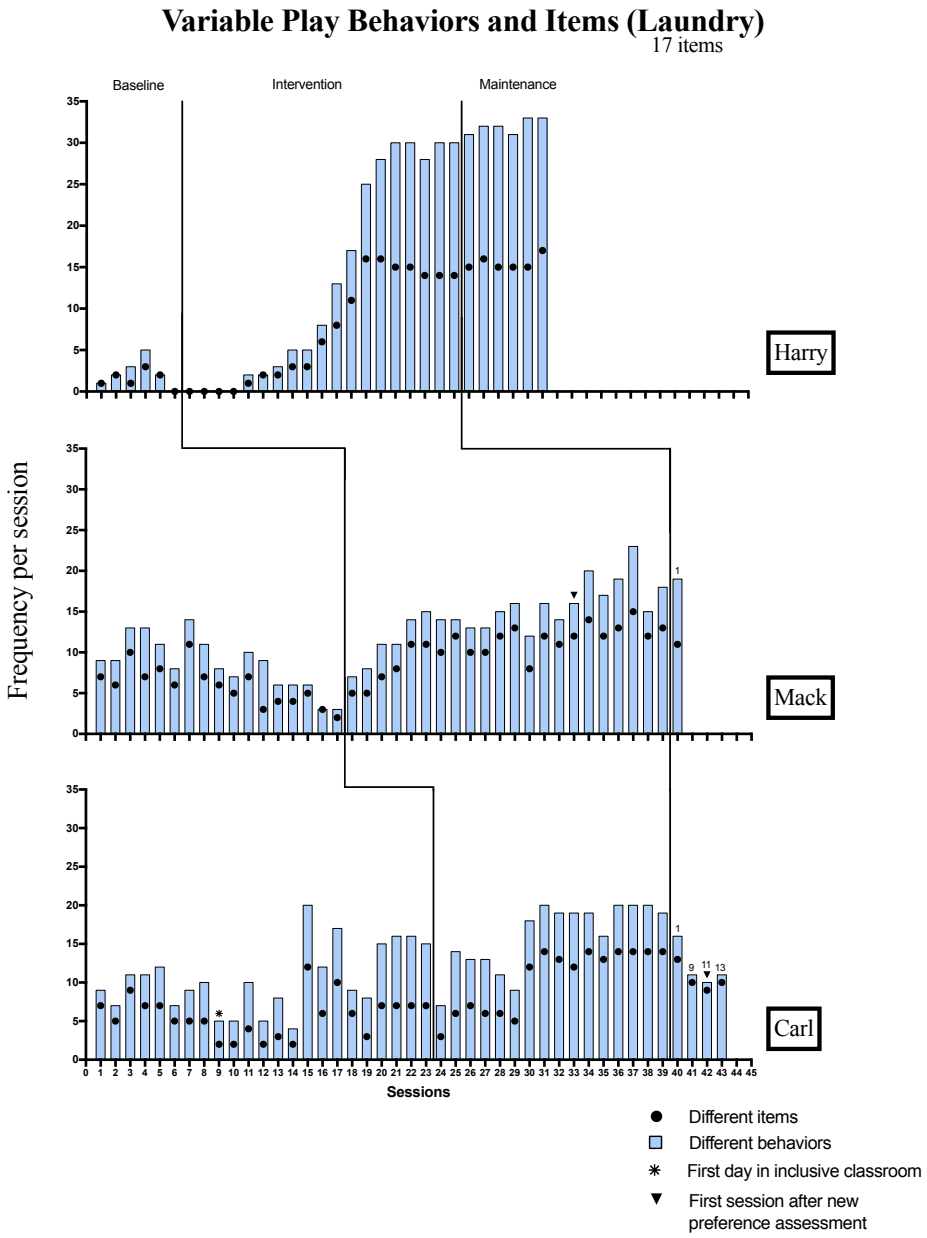

Figure 1. Number of different behaviors displayed and number of different items used in each sessions with the laundry playset across all three children.

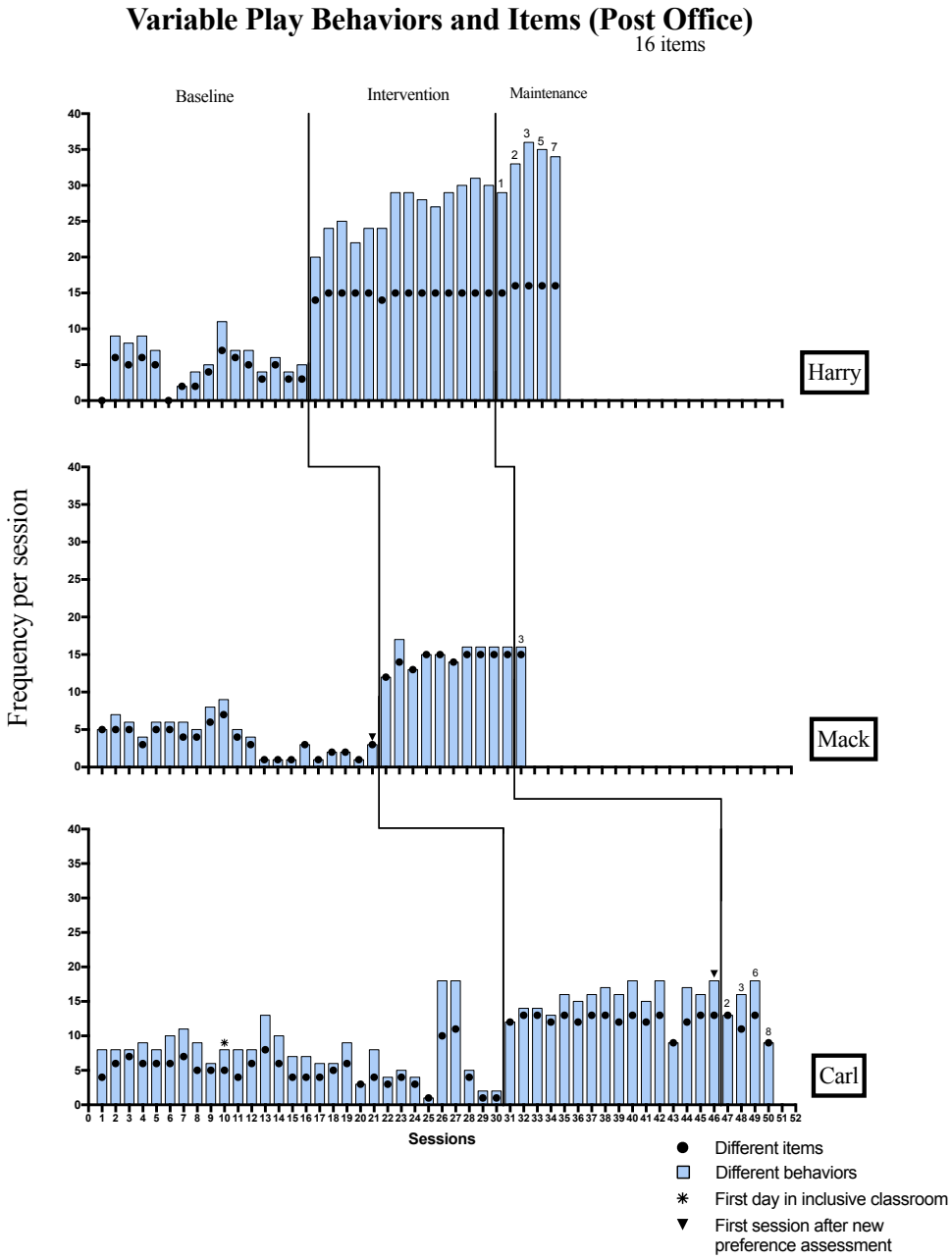

Figure 2. Number of different behaviors displayed and number of different items used in each sessions with the post office playset across all three children.

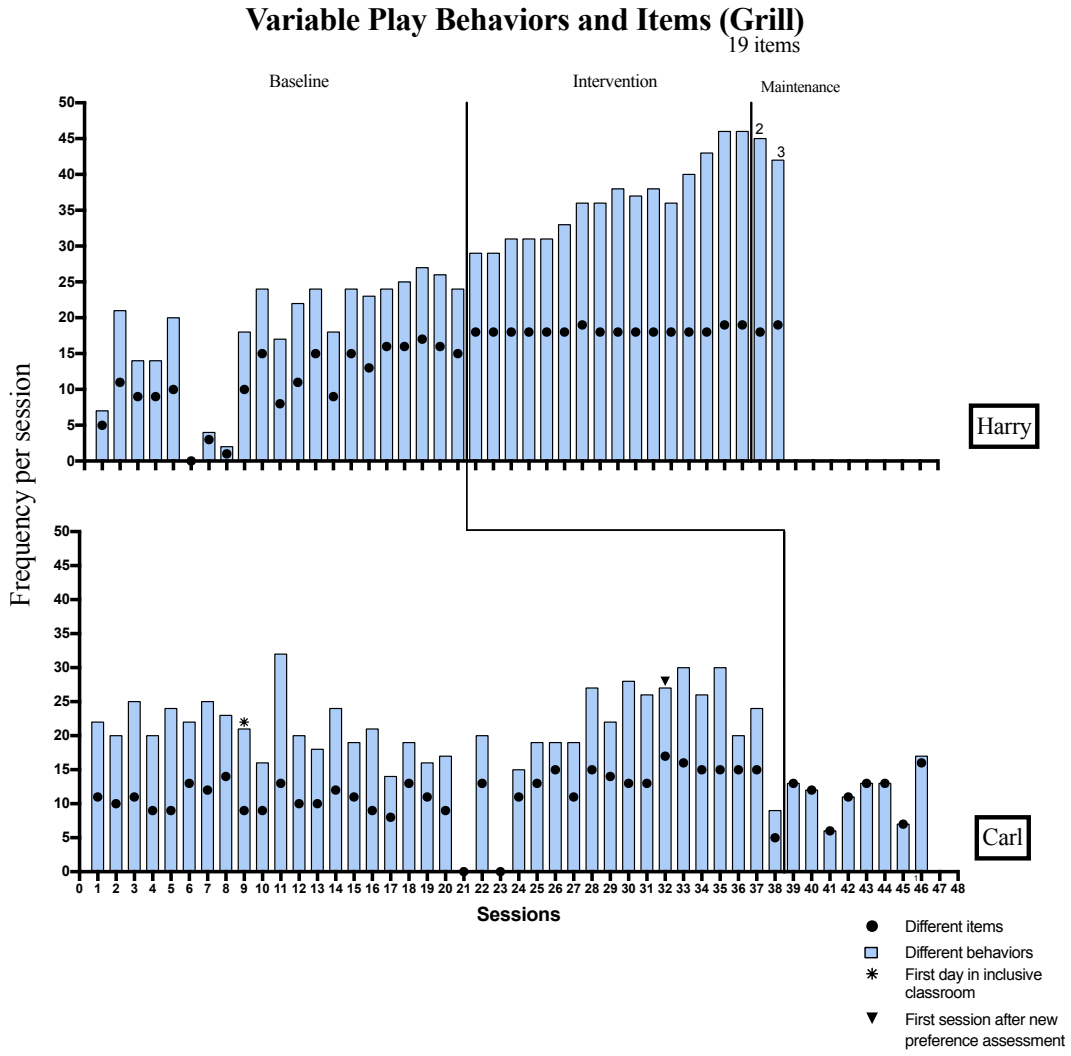

Figure 3. Number of different behaviors displayed and number of different items used in each sessions with the grill playset across all three children.

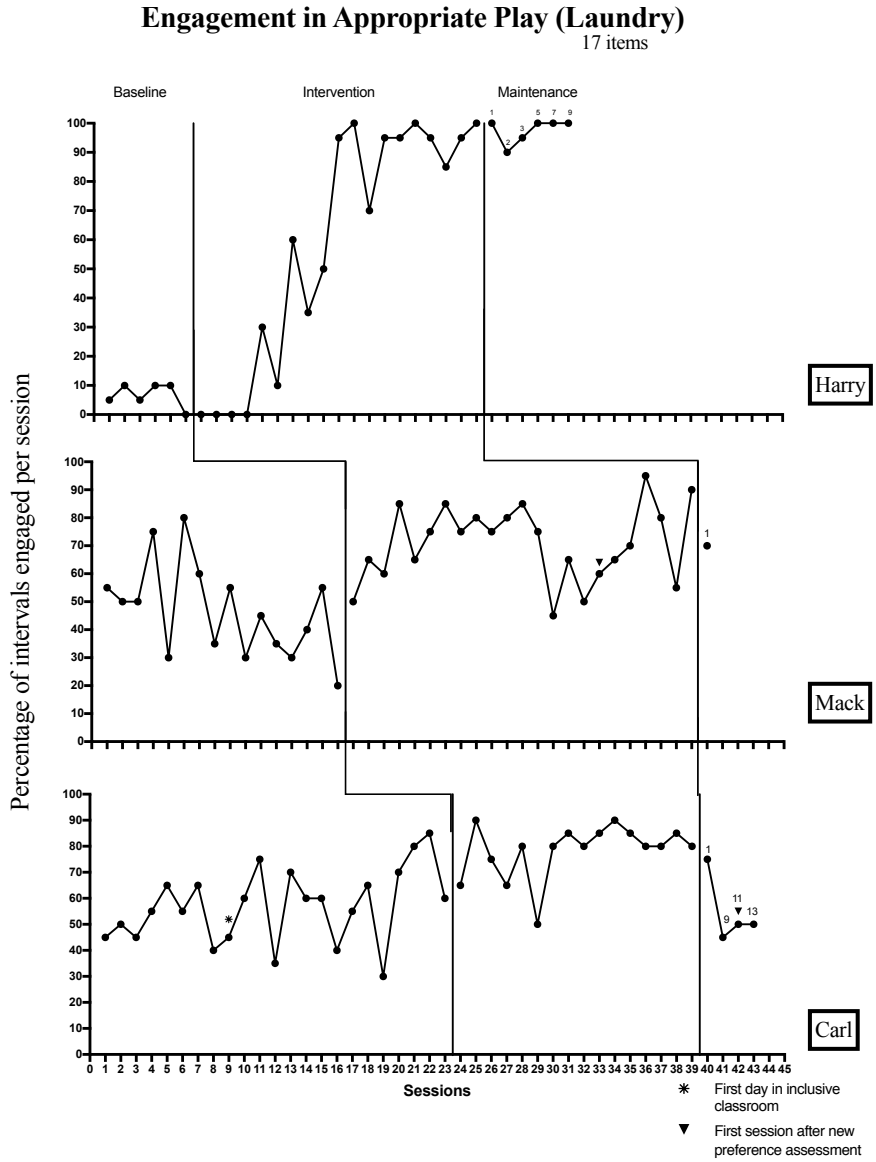

Figure 4. Percentage of each child's engagement in appropriate pretend play during each session with the laundry playset.

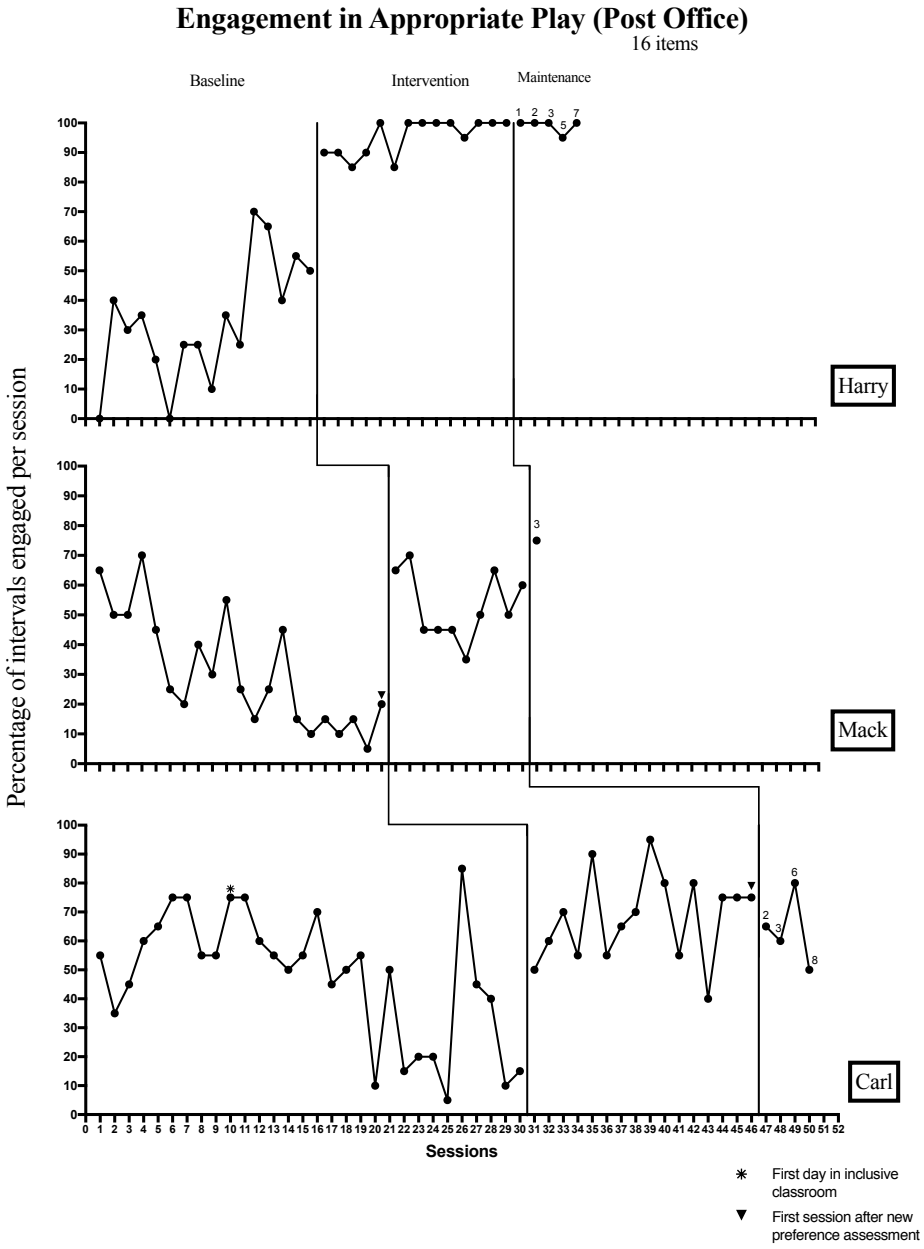

Figure 5. Percentage of each child's engagement in appropriate pretend play during each session with the post office playset.

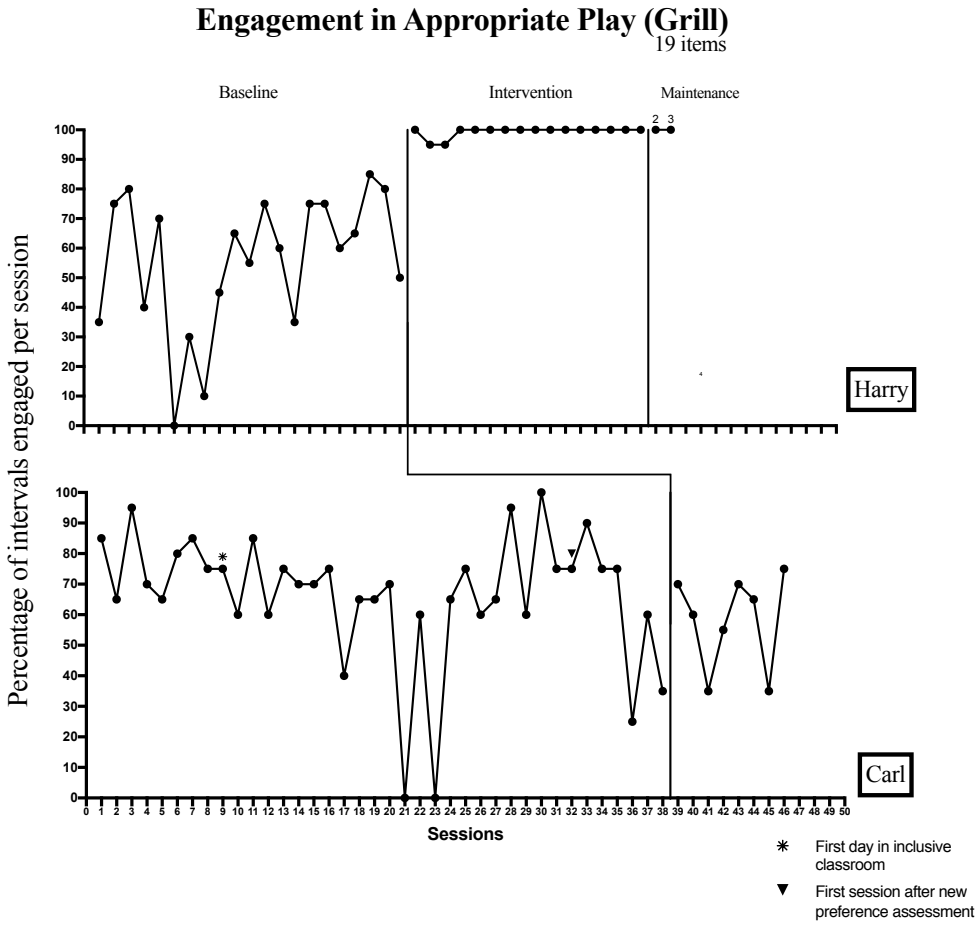

Figure 6. Percentage of each child's engagement in appropriate pretend play during each session with the grill playset.

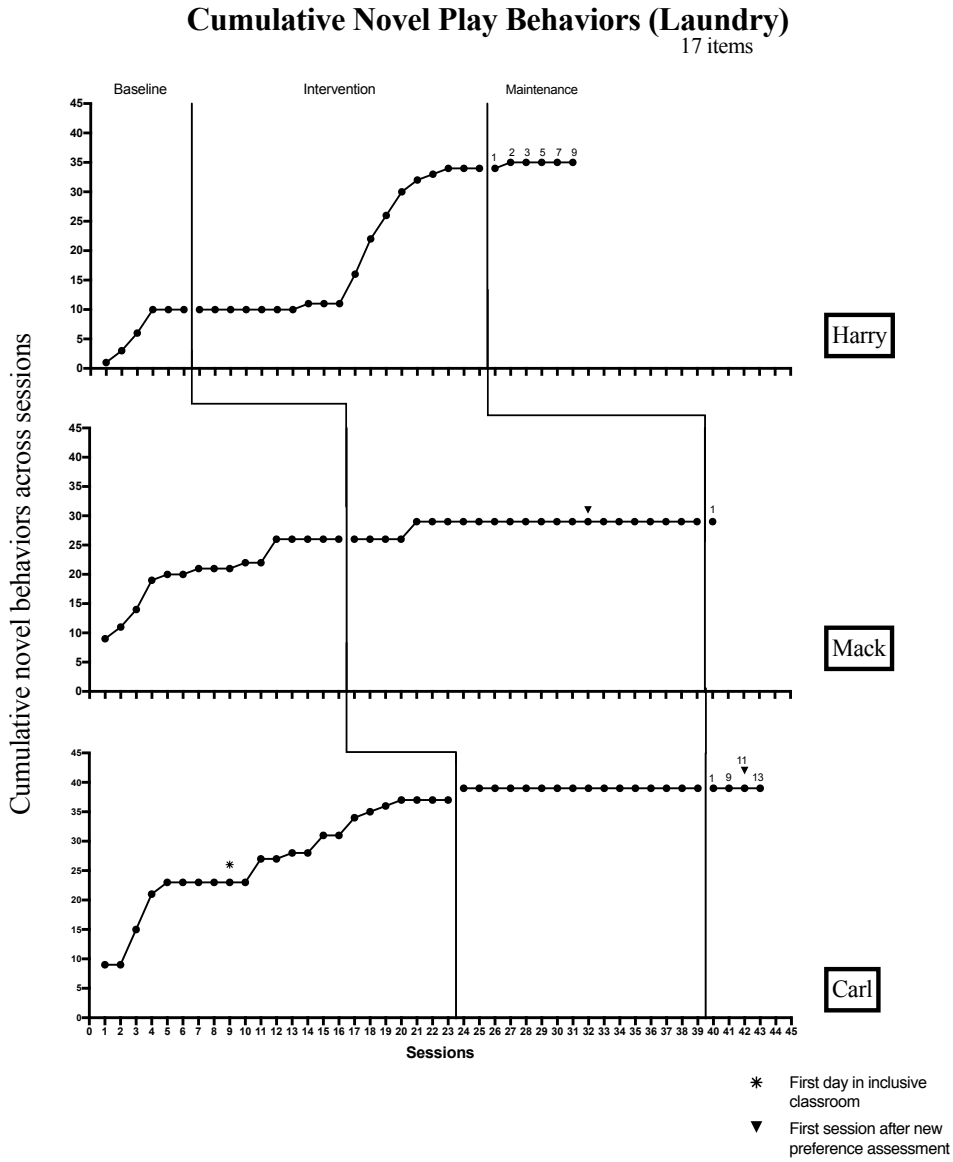

Figure 7. Cumulative record of the novel pretend play behavior of all three children with the laundry playset.

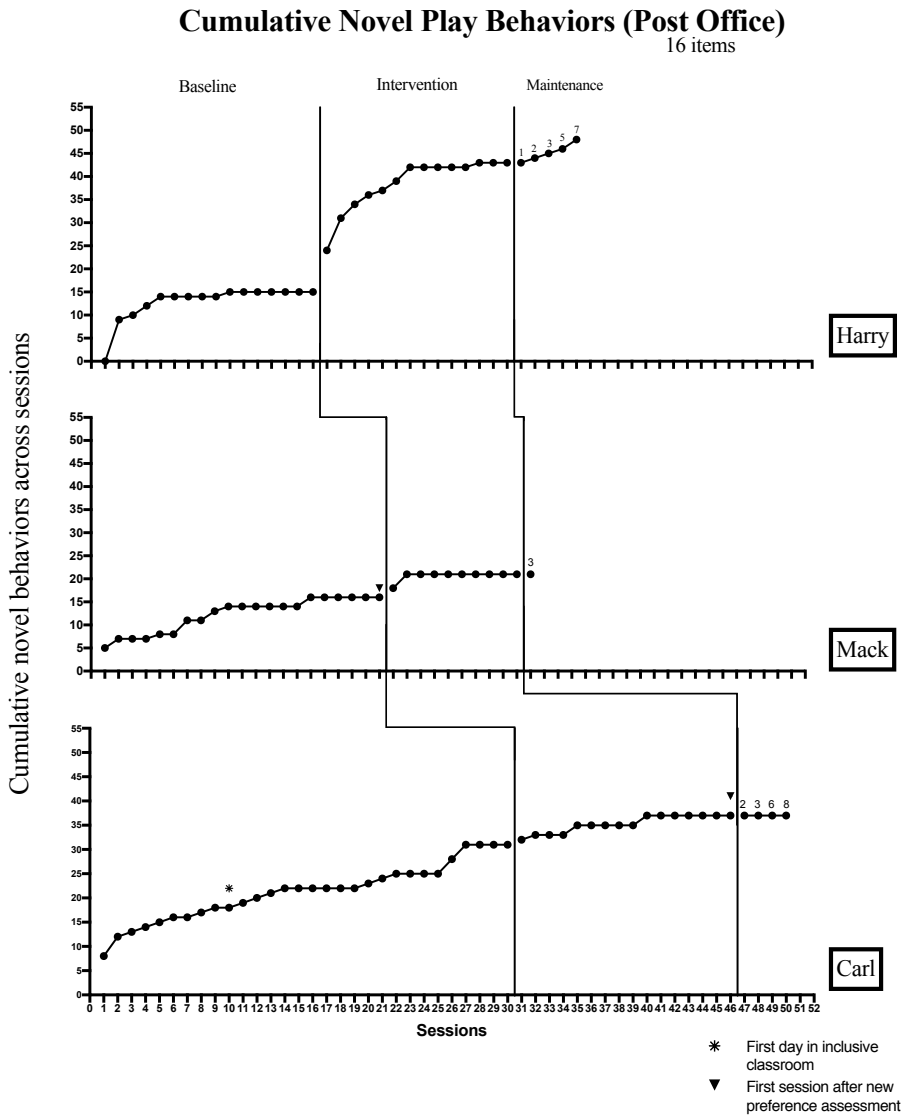

Figure 8. Cumulative record of the novel pretend play behavior of all three children with the post office playset.

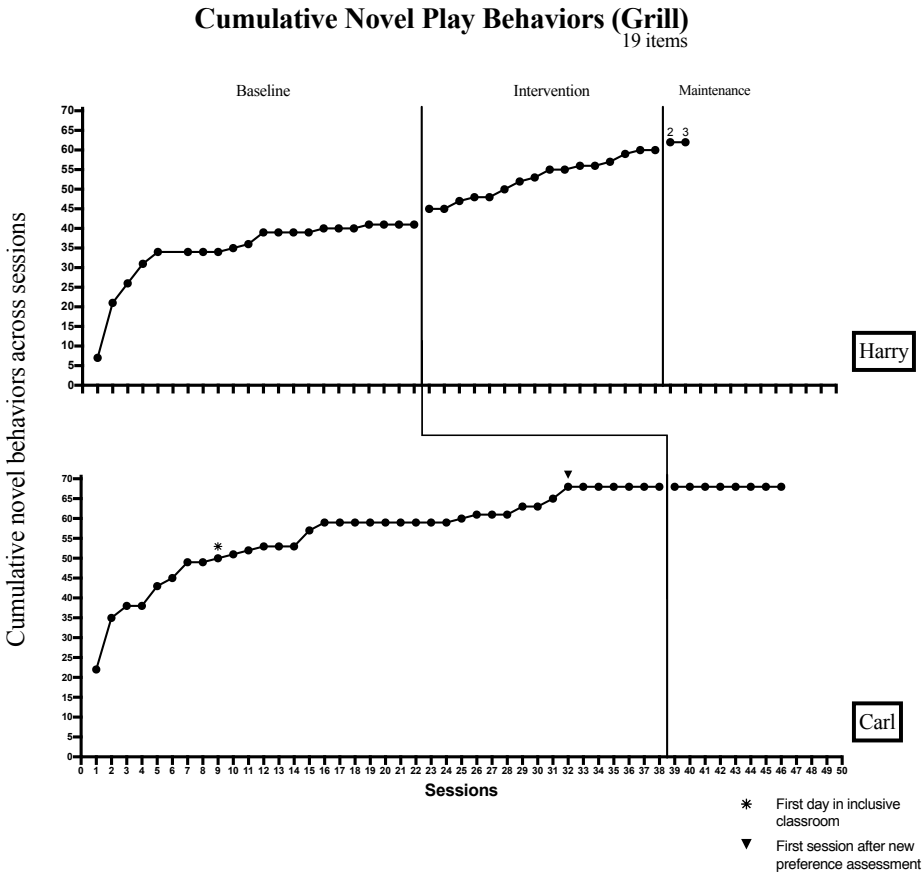

Figure 9. Cumulative record of the novel pretend play behavior of all three children with the grill playset.

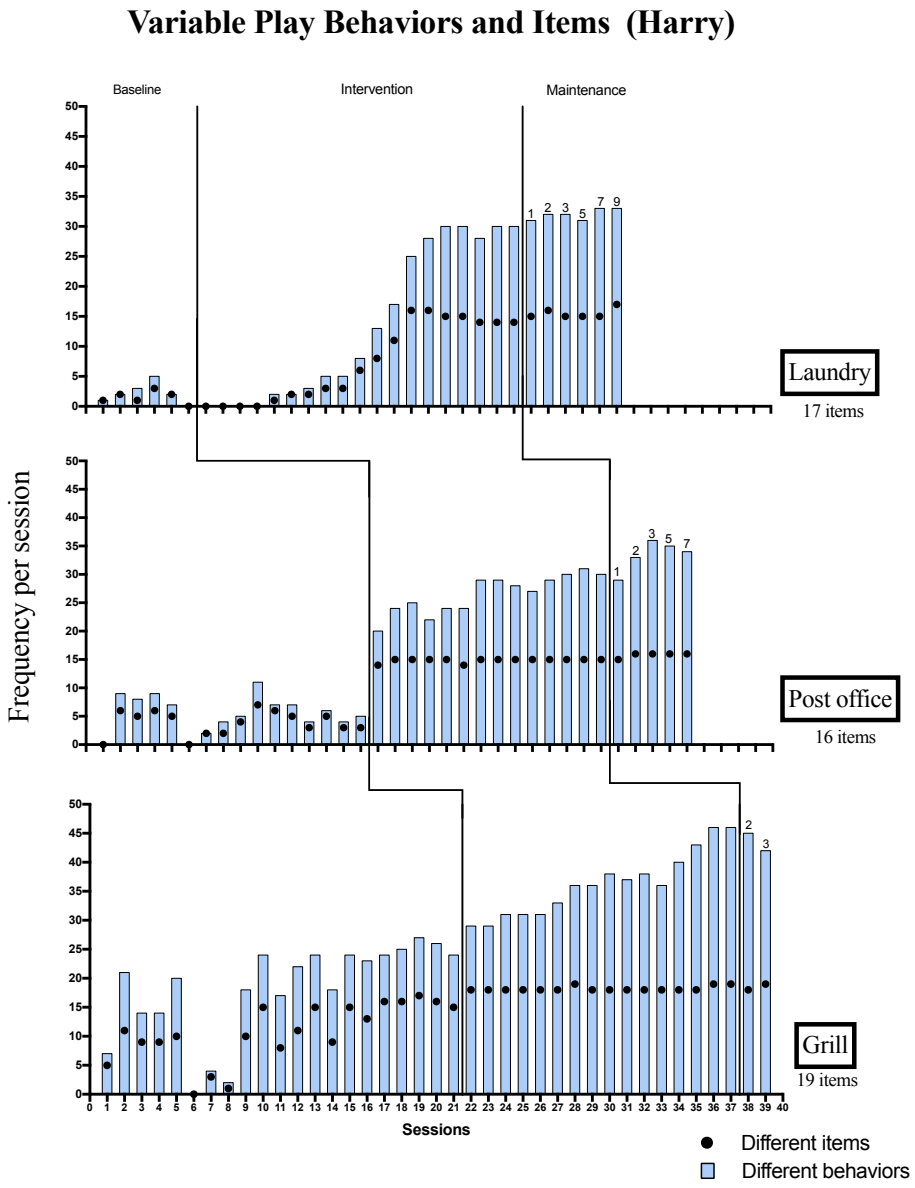

Figure 10. Harry's number of different behaviors displayed and number of different items used in each sessions across all three playsets.

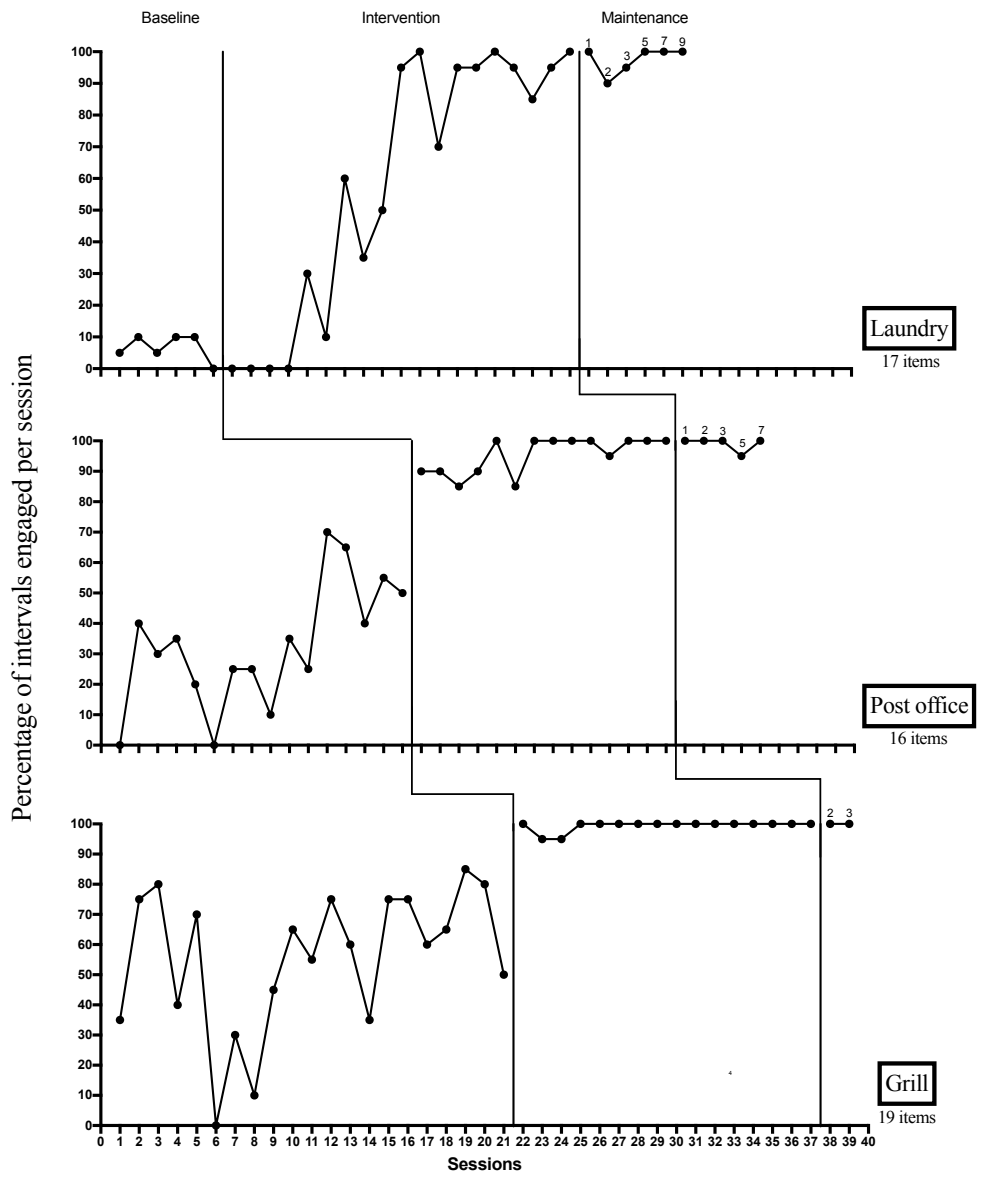

Figure 11. Harry's percentage of engagement in appropriate pretend play during each session across all three playsets.

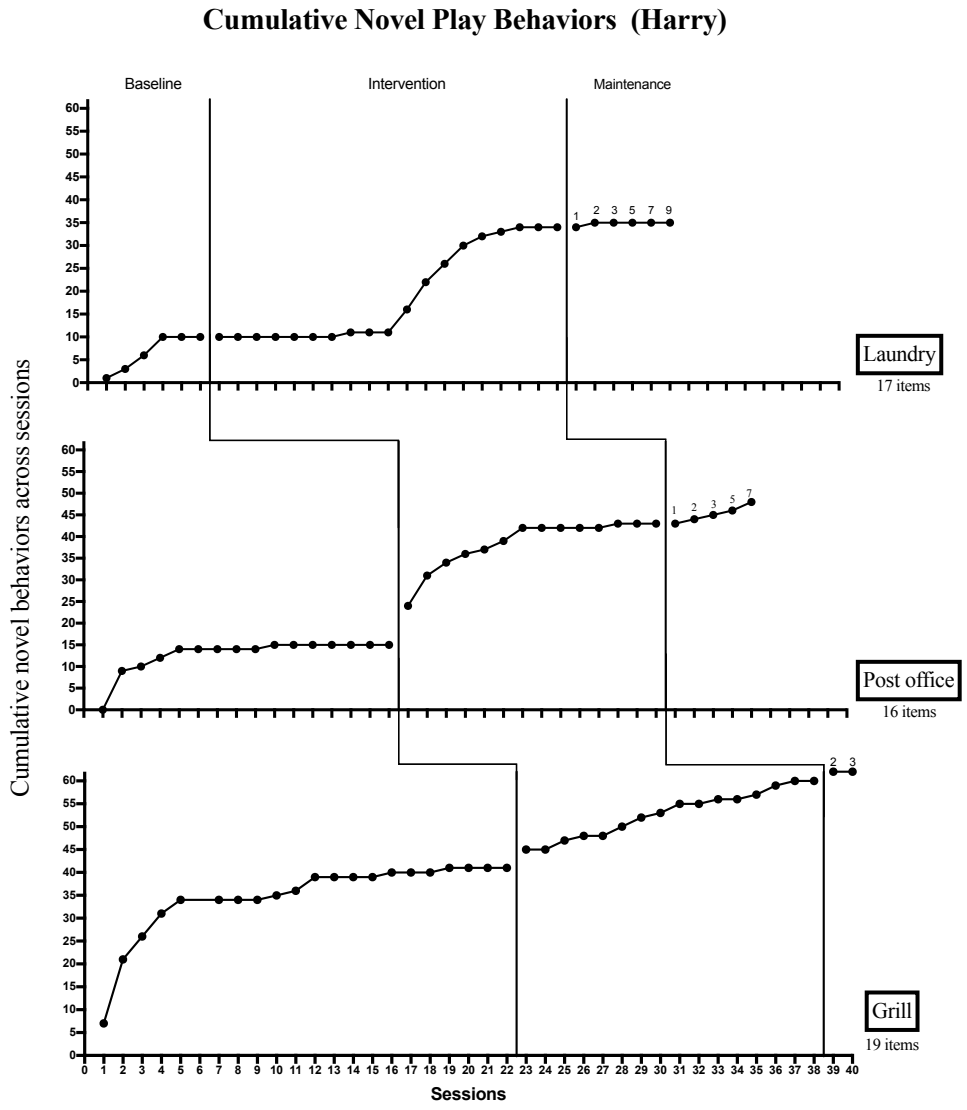

Figure 12. Cumulative record of Harry's novel pretend play behaviors across all three playsets.

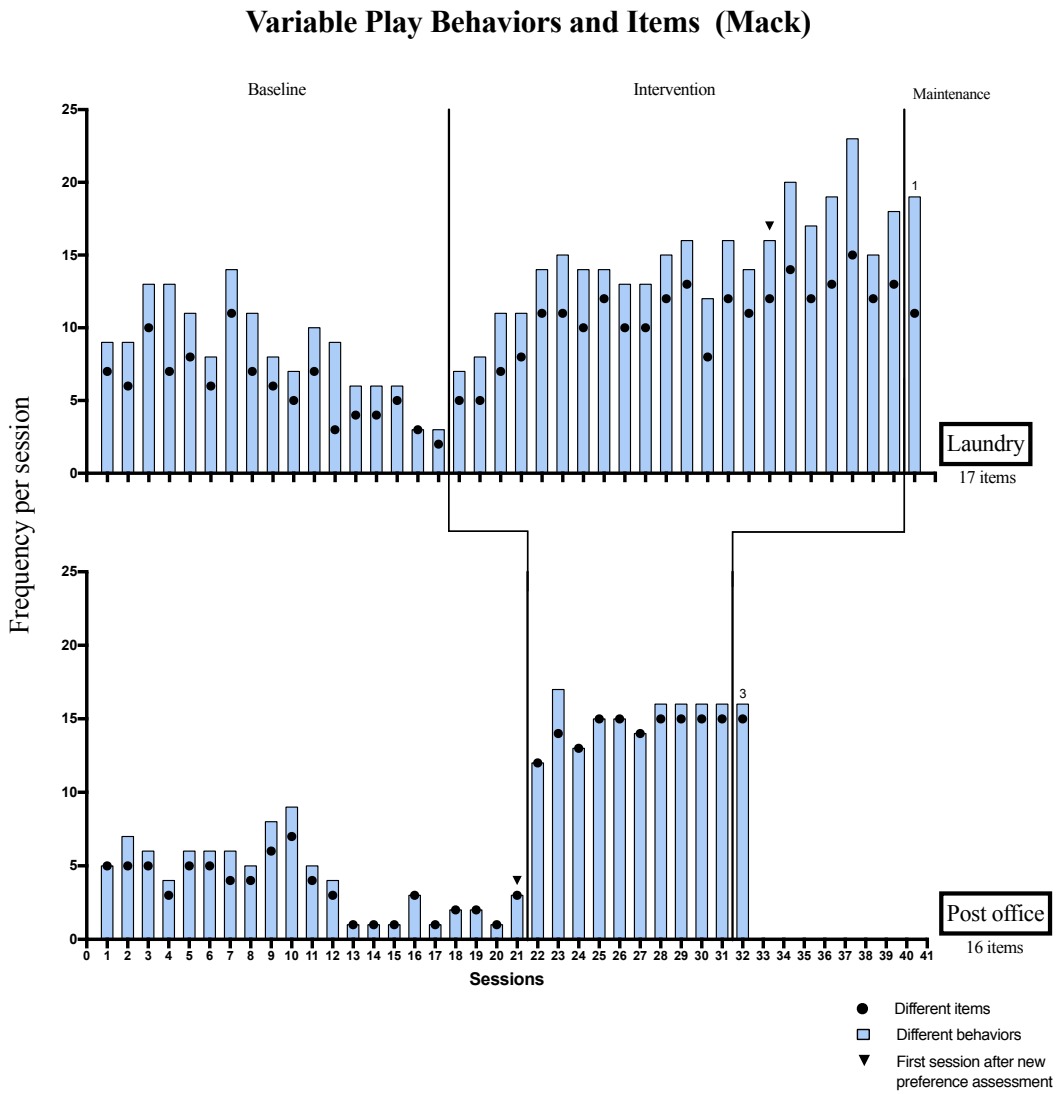

Figure 13. Mack's number of different behaviors displayed and number of different items used in each session across the laundry and post office playsets.

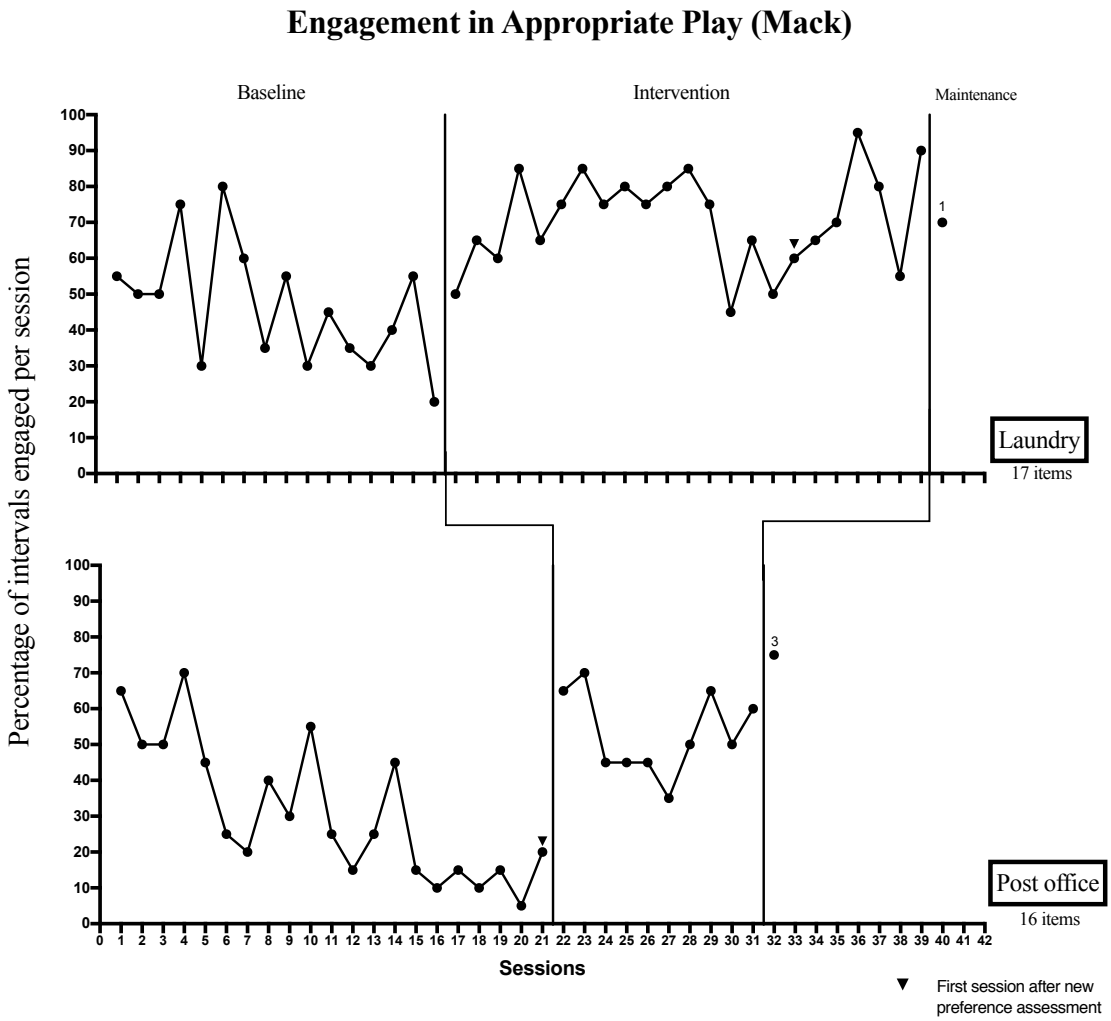

Figure 14. Mack's percentage of engagement in appropriate pretend play during each session across the laundry and post office playsets.

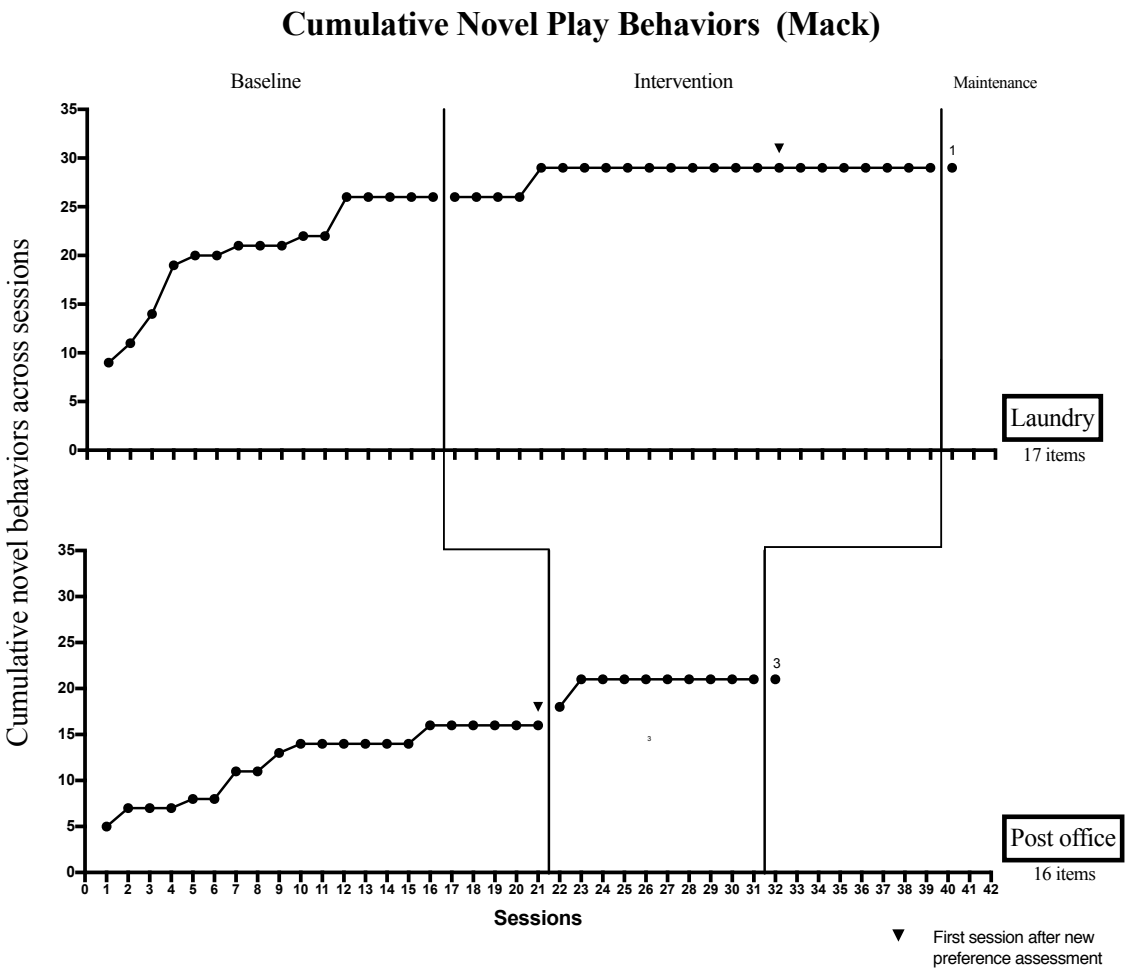

Figure 15. Cumulative record of Mack's novel pretend play behaviors across the laundry and post office playsets.

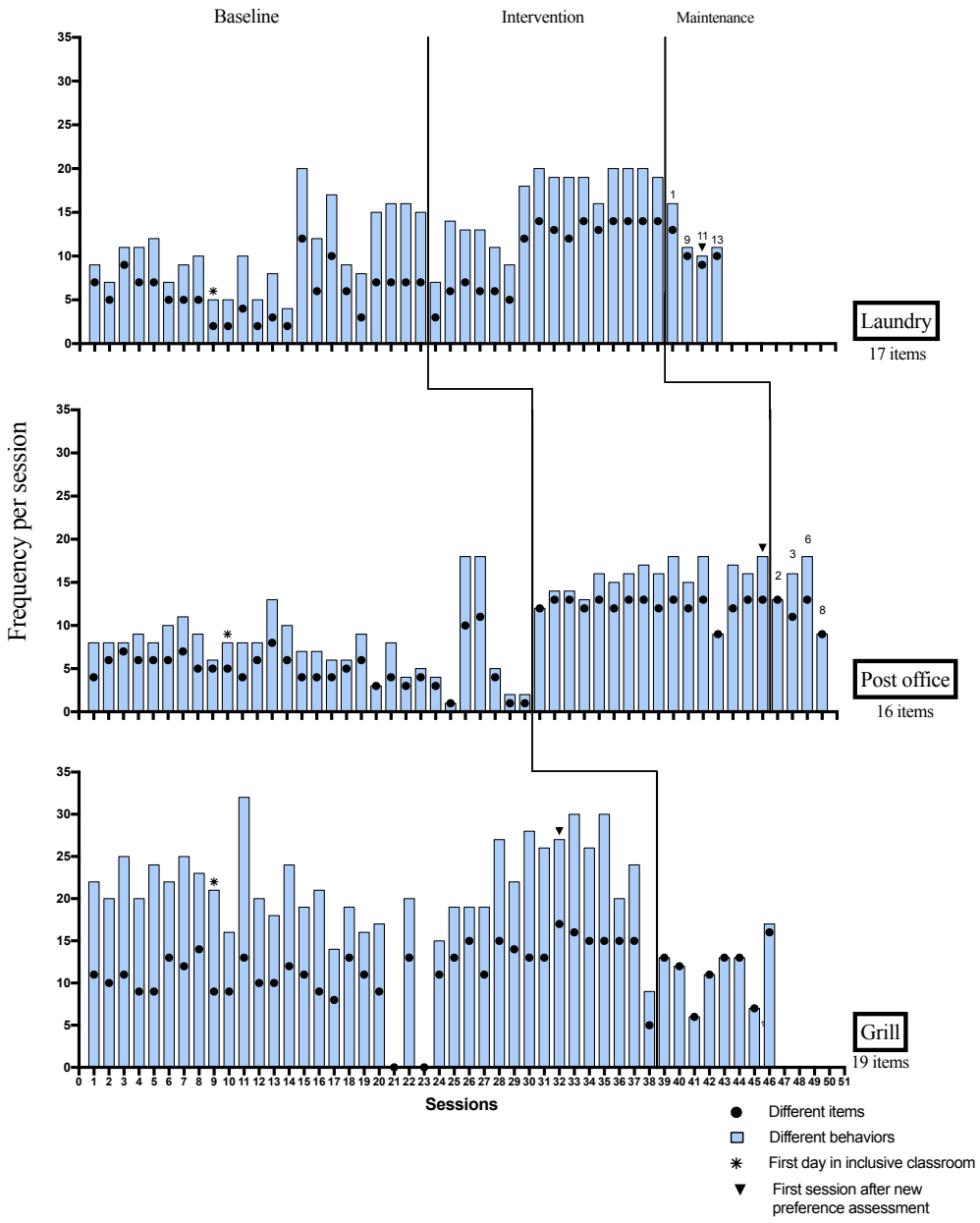

Figure 16. Carl's number of different behaviors displayed and number of different items used in each session across all three playsets.

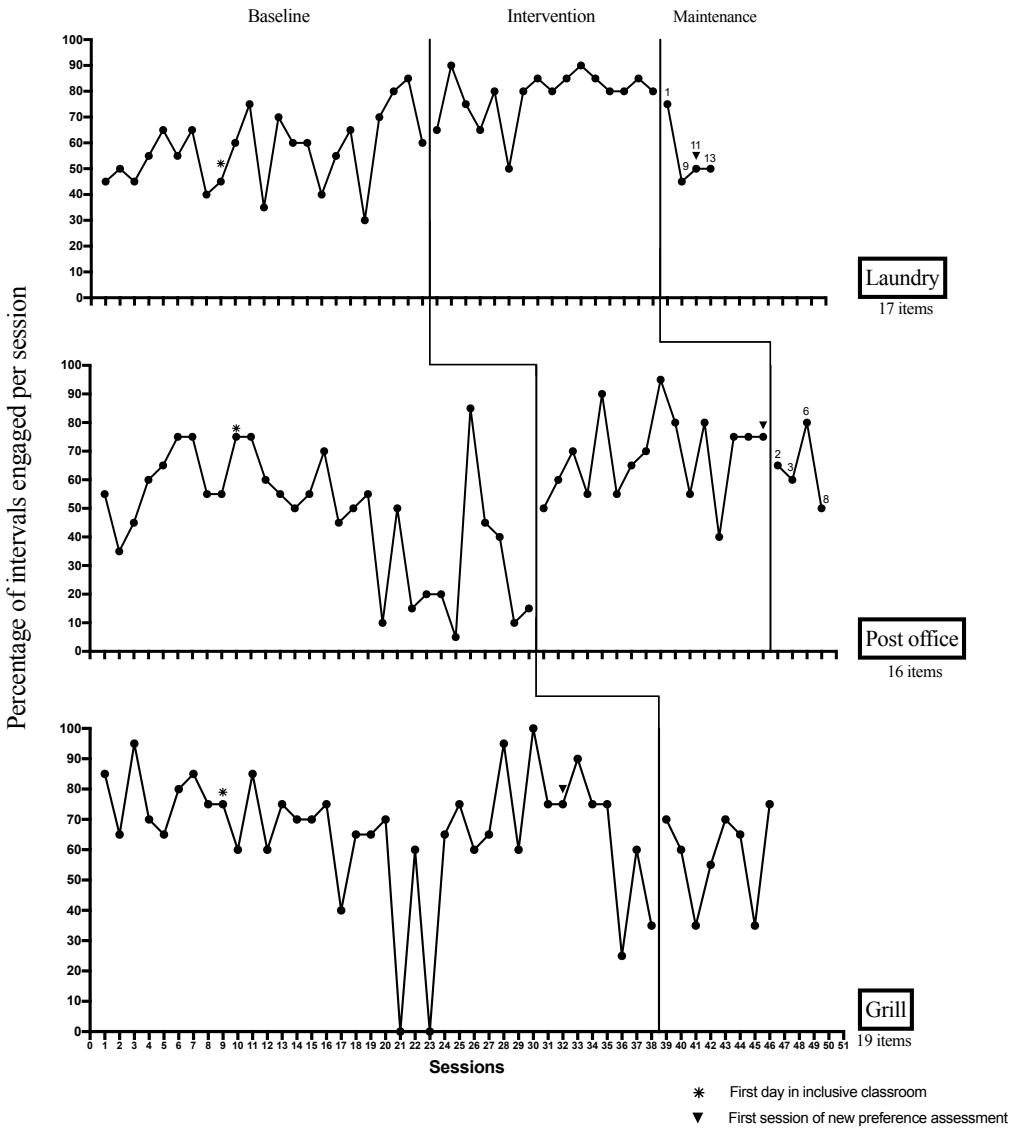

Figure 17. Carl's percentage of engagement in appropriate pretend play during each session across all three playsets.

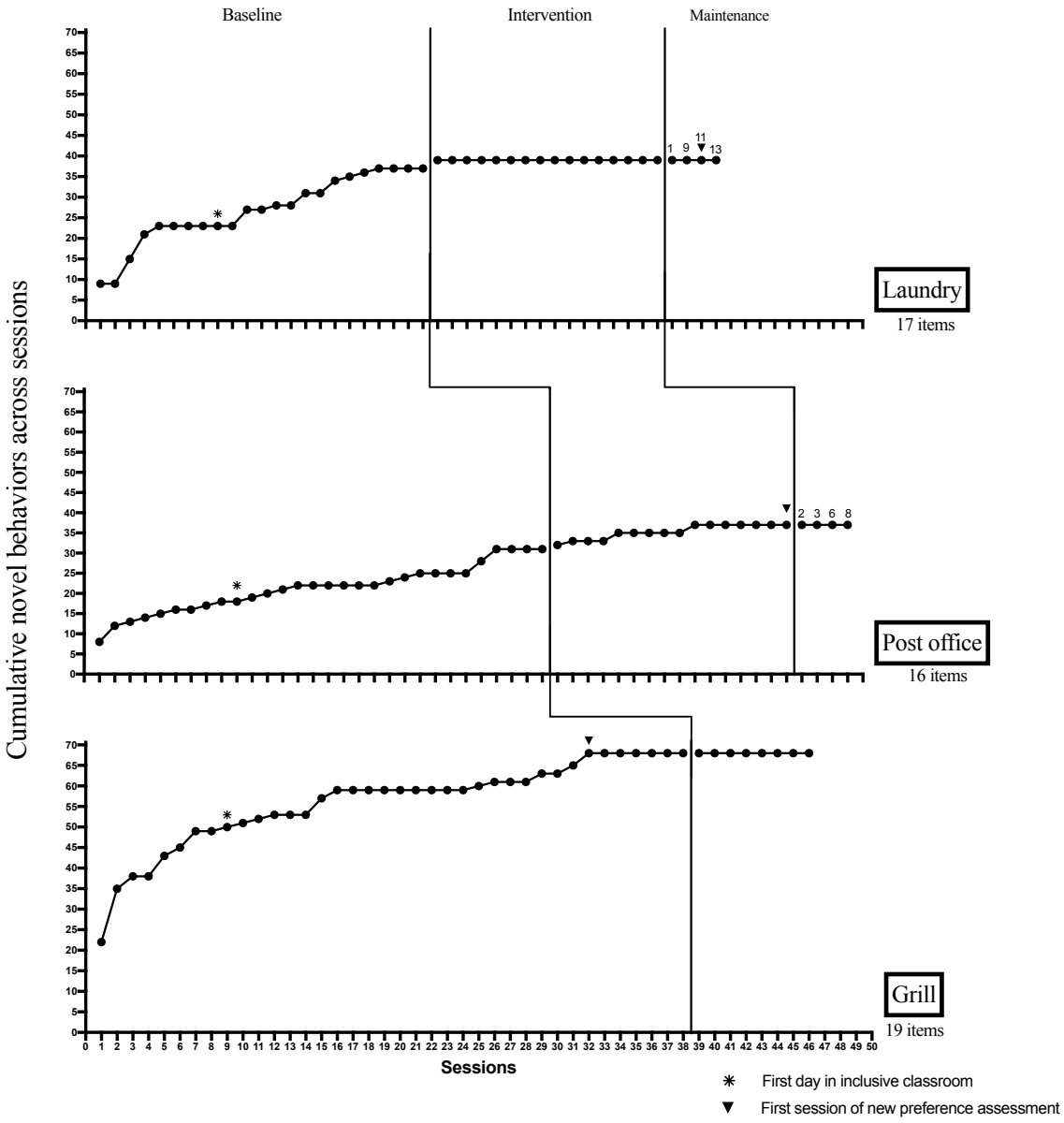

Figure 18. Cumulative record of Carl's novel pretend play behaviors across all three playsets.

Appendix A

Items Included in Each Playset

	Laundry	Post Office	Grill
n	17	16	19
	box of dryer sheets	blank paper (4)	apron
	dryer buttons	calculator	burner
	dryer dials (2)	ink stamp	cup
	dryer door	large box	fork
	dryer spinner	large envelope (2)	grill
	iron	mail bag	grill knobs (3)
	ironing board	mailbox	hamburger bun
	laundry basket	pen	hamburger patty
	laundry detergent	postcard	hot dog
	pants	ruler	hot dog bun
	shirts (2)	scale	ketchup
	socks (4)	shirt	knife
	spray bottle	small box	napkin
	washer buttons	small envelope (2)	oven
	washer dials (2)	stamp pad	pan
	washer door	sticker stamps	plate (2)
	washer spinner		sink
			spatula
			tongs

Appendix B

Parent survey of pretend playsets and materials

Below are some questions regarding pretend playsets with which your child has played. Pretend play sets include any set of toys that allows your child to act out "real life" scenarios. Examples of pretend playsets might include child-size kitchen sets (e.g. pans, pretend food), toy doctor materials (e.g. bandages, stethoscope, thermometers), and toy materials to play "house" such as baby dolls, strollers, and cribs. Please answer the following questions to the best of your ability and return this survey to the primary investigator (Alyson Buck). Thank you!

Please list any pretend playsets and toys that your child plays with **at home**. After each listed playset please indicate how frequently your child engages with each set of items by circling either almost never, once a month, a few times a month, once a week, or almost daily.				
1.				
Approximately how often does your child engage with these play materials?				
Almost never	Once a month	A few times a month	Once a week	Almost daily
2.				
Approximately how often does your child engage with these play materials?				
Almost never	Once a month	A few times a month	Once a week	Almost daily
3.				
Approximately how often does your child engage with these play materials?				
Almost never	Once a month	A few times a month	Once a week	Almost daily
4.				
Approximately how often does your child engage with these play materials?				
Almost never	Once a month	A few times a month	Once a week	Almost daily
5.				
Approximately how often does your child engage with these play materials?				
Almost never	Once a month	A few times a month	Once a week	Almost daily

Please list any pretend playsets and toys that your child plays with **in other homes or environments** (e.g. friends, grandparents, other relatives, play centers). After each listed playset please indicate how frequently your child engages with each set of items by circling either almost never, once a month, a few times a month, once a week, or almost daily.				
1.				
Approximately how often does your child engage with these play materials?				
Almost never	Once a month	A few times a month	Once a week	Almost daily
2.				
Approximately how often does your child engage with these play materials?				
Almost never	Once a month	A few times a month	Once a week	Almost daily
3.				
Approximately how often does your child engage with these play materials?				
Almost never	Once a month	A few times a month	Once a week	Almost daily
4.				
Approximately how often does your child engage with these play materials?				
Almost never	Once a month	A few times a month	Once a week	Almost daily
5.				
Approximately how often does your child engage with these play materials?				
Almost never	Once a month	A few times a month	Once a week	Almost daily

Please answer the following general questions about the playsets and materials you have listed above:

1. Will your child engage alone with the playsets you have listed?

Yes No

If no, please list individuals with whom your child typically plays with these items.

2. Does your child typically initiate play independently with the playsets and toys you have listed? Please circle yes or no.

Yes No

If no, how much encouragement would you say your child needs in order to play with these items? Please circle one.

Almost no encouragement Some encouragement Quite a bit of encouragement

3. On average, how long does your child engage with the playsets you have listed before he or she gets bored or moves on to a different toy? Please circle one.

Less than 5 minutes 5 minutes 10 minutes More than 10 minutes

3. Do any of the following behaviors ever occur while your child is playing with the playsets you have listed (please check the box next to each item that occurs)?:

- ☐ Appropriately plays with toys
- ☐ Throws toys
- ☐ Makes statements or sounds that are relevant to the playset
- ☐ Inappropriately or repetitively engages with items
- ☐ Appropriately plays with peers or siblings
- ☐ Hits peer or sibling with toys
- ☐ Plays with only one or two items in the playset

4. Please provide any additional information about your child's typical pretend play behavior:

Appendix C

Operational Definitions

- **Appropriate pretend play behavior –** child engages with the playset and included materials by using them in a way that is consistent with the intended function(s) of the items

- **Variable play behavior (per session) –** any appropriate play behavior that has not occurred previously within the same session

- **Novel play behavior (across study)** - any appropriate play behavior that has not occurred previously in any session in the study

- **No response –** child does not engage in any appropriate play behavior and is not in contact with any items included in the playset; child touches an item included in the playset but does not pick it up or use it in any way

- **Non-targeted response –** child engages with the playset or included materials in a way that is inconsistent with their intended function(s) (e.g. engages in stereotypy, pretends an item is something else, throws items); child is not appropriately engaged with the playset materials

Appendix D

Reference: Bancroft, S. L., Thompson, R. H., Peters, L. C., Dozier, C. L., & Harper, A. M. (2016). Behavioral variability in the play of children with autism and their typically developing peers. *Behavioral Interventions*, 31(2), 107-119.

<table>
<tr><td>Purpose:
To compare levels of response variability in children with ASD and typically-developing children in a trial-based format with many response options, across multiple play activities

Evaluate whether typically-developing responded more variably

Wanted to know the prevalence of variable responding across ages</td><td>Setting & participants:
30 TDC; 30 CWA, ages 2-8

Experimental design:</td><td>Materials:
Beading a string (11 different beads), paper dolls and outfits (11 outfits), coloring (11 different color markers)

Limitations:
• Did not test for correlations between variability and adaptive test scores
• Did not test to see if level of variability with these play activities was predictive of variable choices elsewhere, such as free play selections and invariable play with a chosen toy</td><td rowspan="2">Results:
• CWA less likely that TDC to respond variably – consistent across each task
• Did not differ significantly in age groups 2, 5, or 6+ years
• Significant difference in variability in 3 and 4 age groups (TDC was higher)
• Proportion of TDC that demonstrate high variability increases as age increases from 2-6+ (stable across age for CWA)</td></tr>
<tr><td>IV:
No intervention: just measured for comparison</td><td>DV:
Frequency of variations (i.e. number of different stimuli selected) recorded per session; categorized performance as high, moderate, or low variability</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
Permanent product examined for 35% of sessions – if disagreement, a third person was asked; this only happened 4 times throughout the study</td><td colspan="2">Generalization/Maintenance:
Overall similarity in variability across play activities used suggests that the results are likely to generalize to other play activities</td></tr>
</table>

Reference: Barton, E. E., & Wolery, M. (2008). Teaching pretend play to children with disabilities: A review of the literature. *Topics in Early Childhood Special Education, 20* (2), 109-125.

<table>
<tr><td>Purpose:
Analyze literature regarding interventions for promoting pretend play in children with disabilities
Review play studies systematically to ID effective interventions for teaching pretend play to preschoolers with disabilities

DVs, participants, measurement contexts, designs, IVs, and rigor of methodology and analysis were all examined to generate a list of recommended practices</td><td>Setting & participants:
16 studies after search

Peer-reviewed, English
Participants were ages 10 and under

Experimental design:
Had to have pre- and post-intervention measures to be included

14/16 used single-subject, 2 used group</td><td>Materials:

Limitations:
• Lack of programming for generalization
• Lack of procedural fidelity in most of the studies reviewed
• Inconsistent definitions of pretend play
• Only 10/14 single subject established believable functional relations
• Unstable BLs and insufficient replications
• Few studies included children under 3 years old</td><td rowspan="2">Results:
• Lack of scope in interventions: most focused on modeling and prompting in some form
• Teachers can systematically prompt functional play with pretense, object substitution, imagining absent objects, and assigning absent attributes using specific toys and modeling or physical prompting
• More research is needed to inform practice confidently</td></tr>
<tr><td>IV:
Prompting, modeling, scripts, video models, modified PRT, imitation, linguistic mapping</td><td>DV:
Pretense behaviors</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
15/16 provided this info for DVs: min. of 20% of observations across participants, and at least 80% agreement
2/16 provided adequate info on procedural fidelity (i.e. above 90%)</td><td colspan="2">Generalization/Maintenance:
Reported in 4 studies: 2 reported generalization across settings, toys, and adults
1 reported gen. across toys
Several trained multiple exemplars</td></tr>
</table>

Reference: Boudreau, E., & D'Entrement, B. (2010). Improving the pretend play skills of preschoolers with autism spectrum disorders: The effects of video modeling. *Journal of Developmental and Physical Disabilities, (22)*, 415-431.

<table>
<tr><td>Purpose:
Examine efficacy of video modeling in teaching play skills to two boys with ASD</td><td>Setting & participants:
1:1 cubby in clinical setting (2 by 3 m.)

2 boy, age 4, autism</td><td>Materials:
Child 1: veterinarian set, Child 2: Construction set</td><td rowspan="3">Results:
Video modeling intervention led to rapid acquisition of modeled actions and scripted verbalizations; novel play decreased with repeated video viewing and intro of Sr+; generalization increased novel play; short-term maintenance for both, long-term for 1</td></tr>
<tr><td></td><td>Experimental design:
multiple baseline across participants</td><td>Limitations:</td></tr>
<tr><td>IV:
Video shown prior to session, reinforcement for modeled actions and scripted verbalizations</td><td>DV:
modeled/unmodeled actions, # scripted/unscripted verbalizations</td><td></td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
32% for 1, 20% for 2- (correlation); modeled actions (1.0, .99), unmodeled actions (.84, .91), scripted verb. (.99, .99)</td><td colspan="2">Generalization/Maintenance:
Its own phase - original toys replaced w/novel toys w/common characteristic; also done across settings w/same materials
Own phase - observed playing with toys sets w/o viewing video, no Sr+; both short and long term</td></tr>
</table>

Reference: Cammilleri, A. P. & Hanley, G. P. (2005). Use of a lag differential reinforcement contingency to increase varied selections of classroom activities. *Journal of Applied Behavior Analysis, 38*, 111-115.

<table>
<tr><td>Purpose:
Evaluate the use of a lag schedule in increasing varied activity selection in an analogue classroom setting</td><td>Setting & participants:
Unused classroom

2 typically-developing girls (5 and 7 years)</td><td>Materials:
12 activities – including programmed and unprogrammed activities</td><td rowspan="3">Results:
Lag differential reinforcement schedule was successful in increasing novel activity selections – both participants began to choose and engage in more variety of activities</td></tr>
<tr><td></td><td>Experimental design:
Reversal</td><td rowspan="2">Limitations:
Contingencies led to higher rates of switching activities, which may not be ideal in many classroom settings

May have been better to use a different control condition for reversal

Conditions that would naturally promote variability in selections were not identified</td></tr>
<tr><td>IV:
Lag schedule of reinforcement

Tokens provided for novel activity selections</td><td>DV:
Activity selection, activity engagement</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
IOA – assessed in at least 30% of sessions and across all phases
100% for activity selection, 93% and 99.8% for activity engagement; mean agreement for all was 87.5%</td><td colspan="2">Generalization/Maintenance:
Effects did not maintain in the absence of the lag schedule (i.e. a reversal was possible)</td></tr>
</table>

Reference: Charlop-Christy, M. H., Le, L., & Freeman, K. A. (2000). A comparison of video modeling with in vivo modeling for teaching children with autism. *Journal of Autism and Developmental Disorder, 30*(6), 537-552.

<table>
<tr><td>Purpose:
Compare effectiveness of in vivo modeling and video modeling to teach children with autism</td><td>Setting & participants:
Therapy room in after-school program (2.4 by 2.6 m)
5, 7-11 years, 4 boys 1 girl, autism</td><td>Method:
Materials:
Different for each participant: emotion cards, car wash games, coloring materials, books containing short stories, playing cards, toothbrush, toothpaste, cup, soap, towel</td><td rowspan="3">Results:
All cases: video modeling required fewer training sessions to mastery; skills taught via video modeling generalized across people, settings, and stim.; video modeling more cost effective; 4/5 participants took less time to skill mastery than in vivo (5th was equal)</td></tr>
<tr><td></td><td>Experimental design:
Multiple baseline across participants</td><td rowspan="2">Limitations:</td></tr>
<tr><td>IV:
Video modeling or in vivo modeling</td><td>DV:
Percent/number correct - different skills for each child: labeling of emotions, indepenent play, spontaneous greetings, oral comprehension, conversational speech, cooperative play, self-help skills, social play</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
all sessions were video-taped for treatment fidelity (99%); IOA ranged from 90-100% for all children</td><td colspan="2">Generalization/Maintenance:
probes using different stim, people, and settings done during BL and 3-5 days after mastery was met - no prompts or Sr+, no feedback</td></tr>
</table>

Reference: D'Ateno, P., Mangiapanello, K., & Taylor, B. A. (2003). Using video modeling to teach complex play sequences to a preschooler with autism. *Journal of Positive Behavior Interventions*, *5*(1), 5-11.

<table>
<tr><td>Purpose:
Assess effects of video modeling along, w/o experimenter-implemented contingencies or prompts, on acquisition of motor and verbal play sequences on a preschool-aged child with autism</td><td>Setting & participants:
1 girl, 3 years, autism</td><td>Materials:
Betty crocker baking set, a toy shopping cart with plastic play food, teach party with table and dishes (baking, shopping, tea party); 3 videos (1 per set)</td><td rowspan="3">Results:
Successful in increasing scripted verbalizations and modeled actions w/o prompting or Sr+, but not novel - perhaps due to only one video per set (lack of sufficient exemplars)</td></tr>
<tr><td></td><td>Experimental design:
Multiple baseline across response categories</td><td rowspan="2">Limitations:</td></tr>
<tr><td>IV:
Video model and prompting procedures</td><td>DV:
# of scripted and unscripted verbal statements; # of modeleing and not-modeling motor responses</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
IOA for 50% of BL and intervention sessions (see pg 7)</td><td colspan="2">Generalization/Maintenance:
not specified</td></tr>
</table>

Reference: Dupere, S., MacDonald, R. P. F., & Ahearn, W. H. (2013). Using video modeling with substitutable loops to teach varied play to children with autism. *Journal of Applied Behavior Analysis, 46*, 662-668.

<table>
<tr><td>Purpose:
Assess the effects of video models with substitutable loops on scripted preted play with trained and untrained characters</td><td>Setting & participants:
small testing room or classroom

3 (1 girl, 2 boys), 5 and 6, autism</td><td>Materials:
3 loops per play set; boat set, train set, zoo set</td><td rowspan="3">Results:
All children mastered the scripts and maintained in postraining and generalization; video modeling is an effective strategy for teaching children scripted actions and vocalizations appropriate to pretend play settings; # of untrained characters used varied per participant</td></tr>
<tr><td></td><td>Experimental design:
multiple probe design across play sets (taught in same order to each child)</td><td>Limitations:</td></tr>
<tr><td>IV:
Video with sequence of play from child's perspective</td><td>DV:
Scripted vocalizations and actions, use of substitutable loops with trained and untrained characters</td><td></td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
IOA for 33% of all sessions for each play set (see p. 664)</td><td colspan="2">Generalization/Maintenance:
"posttraining sessions" identical to baseline; scripted actions and vocalizations were maintainted</td></tr>
</table>

Reference: Eisenberger, R., Armeli, S., & Pretz, J. (1998). Can the promise of reward increase creativity? *Journal of Personality and Social Psychology, 74* (2), 704-714.

<table>
<tr><td>Purpose:
Establish that promises of reward can be effectively used to produce large increases in creative performance when:
a) a previous task required creativity, or
b) the current task explicitly states that creativity is a requirement for reward

(Positive results would dispute the view that expectation of a reward inherently lessens creativity)</td><td>Setting & participants:
Exp. 1: 6 groups of typical 5th graders (n=216)
Exp. 2: 6 groups of typical 5th and 6th graders (n=220)</td><td>Materials:
Word cards of common physical objects

Drawing pages with blank circles</td><td rowspan="3">Results:
• Exp. 1: Children who got Sr+ for creativity in prelim task produced greater creativity on the final task when a reward was promised [they had a previous history of being reinforced for creativity]
• Promise of reward did not increase creativity consistently if children did not have a previous history of Sr+ for creativity
• So, creativity increased on a task where the need for creativity to gain Sr+ was not specified if the child has a previous history of being Sr+ for creativity
• Exp. 2: Creativity increased among children who received instructions for both novelty requirement and quality requirement for creativity
• Overall: Factors that affect creativity:
a) degree required
b) explicitness of relationship to Sr+
c) salience of Sr+</td></tr>
<tr><td></td><td>Experimental design:
Group comparisons</td><td>Limitations:
• Students may have had contact with other students who participated in the study and known about the monetary reward, etc.</td></tr>
<tr><td>IV:
Exp. 1: Participants in 3 groups (no training, usual use training, unusual use training), crossed with differential monetary rewards for the final task (verbal Sr+ used for prelim tasks)
Exp. 2: Participants split into groups based on explicitness of instructions (nonexplicit, low explicit, high explicit)</td><td>DV:
Exp. 1: # of uses for common objects (usual or unusual) – prelim; creativity of circle drawings for final task
Torrance Test of Creative Thinking
Exp. 2: creativity of circle drawings</td><td></td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
Drawings scored independently by two different people; if they disagreed on scores, their scores were averaged (correlation was .97)

Only one rater used in experiment 2, due to high reli in experiment 1 for all but 60 random participants (.99 correlation)</td><td colspan="2">Generalization/Maintenance:
Generalization somewhat implied in the first experiment (creativity measured across tasks) – otherwise, not specified</td></tr>
</table>

Reference: Fein, G. G. (1981). Pretend play in childhood: An integrative review. *Child Development, 52* (4), 1095-1118.

Purpose:	**Definitions:**	**Results:**
Provide a comprehensive review of empirical studies of pretend play in children Determine what is known and what is yet to be determined	• **Pretense** – theoretical construct; behavior in a simulative, nonliteral, or "as if" mode (imaginative, make believe, fantasy, and dramatic play have all been put into this category) – p. 1096	• At this time (1981), no general theory of pretend play existed • Hopefully the study of pretense will contribute to a better understanding of typical development between ages 1 and 6

Reference: Fragale, C. L. (2014). Video modeling interventions to improve play skills of children with autism spectrum disorders: A systematic literature review. *Review Journal of Autism and Developmental Disorders, (1)*, 165-178.

<table>
<tr><td rowspan="3">Purpose:
Identify, analyze and summarize research on video modeling interventions use to improve play-related behaviors in children with ASD

Lack of appropriate play and social skills are diagnostic criteria for ASD – so it is often a target for intervention</td><td>Setting & participants:
22 studies, 57 children with ASD
Solitary and social play</td><td rowspan="2">Results:
Based on 22 studies: Video modeling was an effective intervention to teach play to kids with ASD (82% of participants showed increase in scripted play actions and vocs)

Solitary play: of the 4 studies that measured unscripted play actions, none saw an increase in unscripted play
• 8 overall: one positive, 2 mixed, five no improvements

Some studies added edible reinforcement and/or prompting to the video modeling intervention – this seemed to increase the overall effectiveness of the intervention

Lack of unscripted play was a concern in video modeling: "Given that one of the core characteristics of ASD is a lack of spontaneous play and a penchant for repetitive or routine behaviors, current video model research has not sufficiently addressed this aspect of improving play behavior." (p. 176)</td></tr>
<tr><td>DV:
All included studies measure engagement in play as a DV</td></tr>
<tr><td colspan="2">Generalization/Maintenance:
5/6 studies reported this - positive results across settings and people - mixed results for new toys or materials
Suggest that booster sessions may be needed to maintain for longer time</td></tr>
</table>

Reference: Glover, J., & Gary, A. L. (1976). Procedures to increase some aspects of creativity. *Journal of Applied Behavior Analysis, 9* (1), 79-85.

<table>
<tr><td>Purpose:
Operationally define the components of creative behavior

Related the defined variables to scores on the Torrance Thinking Creatively with Words Test</td><td>Setting & participants:
8 4th-5th grade students (9-10 yrs old)

Volunary 12-week summer school program

Experimental design:
ABCDE</td><td>Materials:
Reading materials present in the room

Limitations:
Cannot specify the differential effects of instructions, reinforcement, practice, or some combo</td><td>Results:
Standardized scores increased on Torrance test of creativity post-intervention

Conditions resulted in increase of the targeted variable during that condition</td></tr>
<tr><td>IV:
BL: Instructed to write down all the possible uses for an object, written on board
Unusual uses game: four unusual uses were explained (DVs, essentially) – class split into teams, got points based on conditions in effect (got 10 min early recess, milk and cookies); conditions on particular days were one of the four variables</td><td>DV:
# of different responses (fluency); # of verb forms (flexibility); # of words per response (elaboration); Statistical infrequency of verb forms (originality)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
IOA of student on-task time (disagreement of 3.1 s across study)
All 4 variables scored by at least 2 scorers daily – used Pearson product moment correlation coefficient (.83, .76, .97, .89)</td><td colspan="2">Generalization/Maintenance:
Not specified</td></tr>
</table>

Reference: Goetz, E. M. (1982). A review of functional analyses of preschool children's creative behaviors. *Education and Treatment of Children, 5* (2), 157-177.

<table>
<tr><td>Purpose:
Review 11 studies that examine creative behaviors of preschoolers
Propose that an overall creativity skill does not exist, but that we may be able to train creativity by conceptualizing it as different response classes</td><td>Experimental design:
Different for each study</td><td rowspan="2">Limitations:
• All individual, rather than group training
• Need more info on long-term effects of creativity training
• Can we do something similar for training creativity in adults?</td><td rowspan="2">Results:
7 tentative conclusions:
• Novel bx may be influenced by different kinds of contingent praise
• Some generalization of creative bx occurs
• Minimal Sr+ contingent on novelty rather than maximal sr+ on form diversity per product, often increases new forms (all studies here used typical kids, though)
• Instructions, prompts, and/or exemplars combined with Sr+ may bring about creative bx
• Mtl. and time limits do not seem to adversely influence creativity training
• Trained creativity is maintained immediately afterwards, sometimes for months
• Flexible code for measurement can be used to individualize training</td></tr>
<tr><td>IV:
Different for each study</td><td>DV:
Creative behavior – making of a new form, or the use of an object in a unique way, relative to previous use for a particular child on a given task (measured specifically for each task)
Creative operants measured by indices realted to fluency, originality, and flexibility</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
% agreement reported averaged in the 90s for all studies reviewed</td><td colspan="2">Generalization/Maintenance:
Both were tested</td></tr>
</table>

Reference: Goetz, E. M., & Baer, D. M. (1973). Social control of form diversity and the emergence of new forms in children's blockbuilding. *Journal of Applied Behavior Analysis, 6*(2), 209-217.

<table>
<tr><td rowspan="2">Purpose:
To determine whether diversity in forms of blocks built by typical preschoolers would increased if directly reinforced using descriptive social praise</td><td>Setting & participants:
University preschool classroom

3 preschool females (age 4)</td><td>Materials:

53 blocks in each session</td><td rowspan="3">Results:
Each child showed an increase in the number of different forms built per session when the intervention was in place when compared to BL

New forms increased, only when different forms were being reinforced

Form diversity decreased when variability was not reinforced

Note: See last page of discussion – helpful</td></tr>
<tr><td>Experimental design:
Reversal (BL [no Sr+], Sr+ different forms, Sr+ same forms, Sr+ different forms)</td><td rowspan="2">Limitations:
Unclear whether change in behavior was due to reinforcement contingency or descriptive portion</td></tr>
<tr><td>IV:
Social reinforcement of new forms made using blocks (first appearance within each session) – Comment pointed out difference</td><td>DV:
Form diversity, new forms (20 specified responses)</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
Not reported</td><td colspan="2">Generalization/Maintenance:
Not reported</td></tr>
</table>

Reference: Jarrold, C. (2003). A review of research into pretend play in autism. *Autism, 7* (4), 379-390.

<table>
<tr><td>Purpose:
Review empirical evidence of difficulties in pretend play in autism and ways in which they have been addressed</td><td>Results:
• Individuals with ASD are less likely to engage in pretend play than their peers
• Children with ASD may possess the skills needed for pretend play, but may not engage spontaneously
• Perhaps children with ASD have the ability to engage in pretend play, but lack motivation to do so

*it is not clear why children typically pretend in the first place – what is the function?</td></tr>
</table>

Reference: Jarrold, C., Boucher, J., & Smith, P. K. (1996). Generativity deficits in pretend play in autism. *British Journal of Developmental Psychology, 14,* 275-300.

<table>
<tr><td>Purpose:
Further test evidence for an underlying capability for pretence in autism by investigating whether children with ASD can carry out pretence in structured circumstances (Exp 1 & 2)
Examine whether a form of “gernerativity” deficit can explain problems in pretend play in ASD (Exp 3)

So, do you children with ASD have an inability to pretend, or is that just under certain circumstances?</td><td>Setting & participants:
1: 14 children with ASD; 14 children with moderate learning disabilities (MLD) (matched for language)
2: Same as exp 1, with one extra matched pair
3: 3 matched groups –ASD, MLD, and typical children (not same 2 groups as before)

Experimental design:
Group comparisons</td><td>Materials:
1: Doll figures and doll plus junk objects (i.e. objects with no play function)
2: Sex-appropriate child doll figure – other materials needs for instructions
3: 8 props in the with props condition – candle, football scarf, plastic colander, plastic serving spoon, clear plastic ruler, plastic card index box, small cylindrical metal tub, large metal cake tin

Limitations:
Although authors stated that they tried to ensure that children were motivated (p. 297), no formal reinforcements were used</td><td rowspan="2">Results:
1: children with MLD showed more pretend play and functional play than children with ASD; children with ASD showed higher levels of manipulative toy play (more in doll plus junk), and higher levels of not playing with the materials
children with ASD were impaired in their production of spontaneous pretend play – this deficit was not alleviated by elicitations
2: Children with ASD were unimpaired relative to matched controls in their ability to act out appropriate responses to instructions to pretend, regardless of type of instruction (See p. 288-289 for a discussion of whether this actually means they are pretending)
3: Children with ASD showed severe deficits in generating pretend play acts; this deficit becomes more pronounced over time (i.e. as the 6-minute session progressed) – engaged in markedly less acts across the play session – not affected by props vs no props – see p. 296-297 for discussion</td></tr>
<tr><td colspan="2">IV:
1: Two test sessions – one set of materials presented – non-specific encouragement to play
2: 12 instructions, 4 of each type (physical, social, emotional) – designed to elicit pretend play substitution, imagination of absent objects, or attitudes
3: Two test conditions: with props and without props – Started with experimenter modeling 3 play acts, then said “What can you pretend to do?” – social praise, verbal prompt for something else, model prompt after 15 s of nothing new</td><td>DV:
1: pretend play, intermediate pretend play, functional play, manipulative play, no play
2: Appropriate instructed play actions
3: Different appropriate pretend play acts (repetitions not scored); verb or object could only be used twice to count</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
1: 4 videos were randomly selected from each group and coded – scores were satisfactory
2: Same as exp 1
3: 3 randomly chosen videos scored for IOA – satisfactory</td><td colspan="2">Generalization/Maintenance:
Not programmed for</td></tr>
</table>

Reference: Jung, S., & Sainato, D. M. (2013). Teaching play skills to young children with autism. *Journal of Intellectual and Developmental Disability, 38* (1), 74-90.

<table>
<tr><td>Purpose:
Identify effective instructional procedures for teaching play skills
Discuss the implications for practice and future research</td><td>Setting & participants:
Literature search using PsychINFO and ERIC
• English, peer-reviewed journals, empirical studies
26 studies within criteria

Limitations:
Studies should address developmental readiness for symbolic play – do children have prerequisite skills? (p. 86)

Inconsistent definitions and descriptions of types of play</td><td rowspan="2">Results:
Variety of instructions strategies have been used to teach play skills:
• Video and live modeling
• Systematic prompting
• Pivotal response training
• Restricted interests
• Activity schedule and correspondence training
• Integrated playgroup model
• Script training
• Social stories

Children with autism responded well to direct play interventions in structured environments
Collateral effects of increasing positive social interactions and decreasing inappropriate bx
Most studies used a combo of strategies (e.g. video modeling with reinforcement, script training with prompting)
Video modeling is most widely used intervention to target play skills</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
Both authors categorized all studies: 100% agreement</td></tr>
<tr><td colspan="2"></td><td>Generalization/Maintenance:
Suggest that teaching play skills in the natural context of a classroom may increase the likelihood that skills will generalize</td></tr>
</table>

Reference: Lalli, J. S., Zanolli, K., & Wohn, T. (1994). Using extinction to promote response variability in toy play. *Journal of Applied Behavior Analysis, 27* (4), 735-736.

<table>
<tr><td>Purpose:
Use extinction and Sr+ of untrained respondent to promote response variability in toy play

Evaluate effects of extinction on untrained toy play</td><td>Setting & participants:
Two children (4 and 5 years), mild developmental delays

Experimental design:
Multiple probe across participants</td><td>Materials:
Plane
Animal or Doll

Limitations:
None listed</td><td>Results:
Neither child engaged in appropriate toy play in baseline; both engaged in trained toy play and increased variable untrained responses when each subsequent response was placed on extinction

Variability can be directly reinforced as a dimension of behavior

Induction may be on way to elicit the occurrence of variable responding</td></tr>
<tr><td>IV:
15-min training session for one topography with each toy (modeling and physical prompts); probe sessions started the next day w/o prompts
• Descr. praise for first occurrence of trained or newest topography
• Placed topography on extinction after 3 more St+ on FI 30s
• Repeat steps 1-2 for each untrained topography in session
• Terminate session after 60s without a new topography
• New session started by Sr+ newest top. from previous session</td><td>DV:
First occurrence of each topography of toy play (10-s partial-interval)
Plane: taxiing, circular, horizontal, upside down, vertical movements for min of 5s, takeoffs, landings, airplane noise, placing passenger on plane, spinner propeller
Animal/doll: walking, dancing, using limbs for min of 5s, showing affection, talking to or for the toy, feeding, grooming, dressing</td><td></td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
IOA: 32% of sessions – 80% or higher for all topographies</td><td colspan="2">Generalization/Maintenance:
Not programmed or measured</td></tr>
</table>

Reference: Lang, R., Machalicek, W., Rispoli, M, O'Reilly, M., Sigafoos, J. Lancioni, G., Peters-Scheffer, N., & Didden, R. (2014). Play skills taught via behavioral intervention generalize, maintain, and persist in the absence of socially mediated reinforcement in children with autism. *Research in Autism Spectrum Disorders, 8,* 860-872.

<table>
<tr><td>Purpose:
Address previous criticisms about behavioral play interventions – specifically, generalization of play skills, continued play in the absence of Sds for socially-mediated St+, happiness/mood of the child, maintenance of play behavior for up to 4 months post-intervention
Demonstrate reduction in stereotypy</td><td>Setting & participants:
School for young kids with DD – in participant's classroom and an individual therapy room
Intervention during daily center time in classroom

3 children with ASD, 3 yrs old – displayed stereotypic behavior with toys

Experimental design:
Mult. BL across participants with embedded ABA design for one part. and embedded ABACA design for two part. (C was lag sched. for generalization if necessary)</td><td>Materials:
4 sets: house, amusement park, doctor's office, and cooking set w/ food

Chosen based on appropriateness for classroom, preference, previous exposure, and age-appropriatenss

Limitations:
• BL conducted in different room than intervention?
• Toy sets were somewhat similar, which may have increased chance of generalization
• Lag only used across 2 participants</td><td>Results:
• All 3 engaged in more appropriate play and less stereotypy following intervention; play skills occurred in absence of teacher and eventually generalized across settings
• 2 mothers rated child as happier post intervention; 1 ratings did not change
• The fact that play maintained for participants when sr+ was no longer provided could indicate that play was automatically reinforced</td></tr>
<tr><td colspan="2">IV:
B: Teacher set out toy set; least to most prompting to directly teach play skills – Sr+ with social praise and small edible contingent on appropriate play (FR1, then VR3)
Interruption and redirection of stereotypy if necessary
C: Sr+ delivered contingent on an appropriate play behavior on Lag 1 schedule (diff Sr+ of variable play) – increased to Lag 2 once consistent – phase ended after 5 sessions at Lag 2</td><td colspan="2">DV:
Appropriate play, stereotypy, and parent ratings of mood, happiness, and interest in play</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
IOA: For approp. play and stereotypy; 33% of sessions; 91% for stereo, 88% for play

Tx integ: 30% of part 1 B phase, 57% of part 2 and 3; 87%, 96%, and 95% on average, respectively
90% and 80% for 2 and 3 during Lag phase, respectively</td><td colspan="2">Generalization/Maintenance:
• Generalized across settings
• Maintained at 4, 6, and 8 weeks post-intervention</td></tr>
</table>

Reference: Leaf, J. B., Taubman, M., Bloomfield, S., Palos-Rafuse, L., Leaf, R., McEachin, J., & Oppenheim, M. L. (2009). Increasing social skills and pro-social behavior for three children diagnosed with autism through the use of a teaching package. *Research in Autism Spectrum Disorders, 3,* 275-289

<table>
<tr>
<td rowspan="2">Purpose:
Assess whether a teaching package that included the TI procedure, priming, and Sr+ was able to increase a variety of social skills for three children with ASD and to evaluate if participants would increase their communication and play toward selected target peers</td>
<td>Setting & participants:
3 kindergarteners with high functioning ASD (male, 5-7)

Private bx intervention summer program, one-on-one room meant to mimic the classroom</td>
<td>Play definition:
Play – at least 2 consecutive s of the participant being on task w/ materials, script, or imaginative game with their target peer free from self-stim, parallel or solitary play</td>
<td rowspan="3">Results:
All participants showed an immediate increase in target skills following the first TI

All increased conversation and play with target peer

Therefore, the teaching package was effective in teaching skills in the domains of play, conversation, emotion, and choosing the same peers for the three participants</td>
</tr>
<tr>
<td>Experimental design:
Multiple BL across skills for each participant</td>
<td rowspan="2">Limitations:
Future: should do component analysis of teaching package

Short period, so no extensive data on generalization

No treatment fidelity</td>
</tr>
<tr>
<td>IV: Probe sessions with typical peer
Teaching package (TI procedure)
• Teacher described skill
• Provide rationale – participant then provided rationale
• Participant states skill steps in bx
• Participant states when and with whom the skill could be used
• Teacher model of bx w/o 1 step
• Participant id'd errors
• Teacher models correctly
• Participant id'd correct bx
• Role play bx/feedback/repeat
*Tokens given for correct answers and responses throughout the day
• Primed to use these skills throughout day</td>
<td>DV:
4 skills in 4 domains: play, language, emotional, choosing the same friend (all deemed necessary to create and maintain friendships by naturalistic observation of typical kids)

Frequency of conversation b/w participant and target peer
% intervals of play with target peer</td>
</tr>
<tr>
<td colspan="2">Tx Integ./Reliability:
In-vivo, point-by-point reli for 30% of probe sessions across the three participants
Mean for skill acquisition: 94.5%, play: 100%, conversation: 88%</td>
<td colspan="2">Generalization/Maintenance:
Need more data on this

Not all skills measured for maintenance, but those that were maintained above BL levels for the most part for all</td>
</tr>
</table>

Reference: Luckett, T., Bundy, A., & Roberts, J. Do behavioral approaches teach children with autism to play or are they pretending? *Autism, 11* (4), 365-388.

<table>
<tr>
<td rowspan="2">Purpose:
Goal was to assess evidence for claims that suggested developments in children's disposition to play

Concern that play should be intrinsically motivating, and that this is not happening in play interventions

Suggest that we look at the motivation for play rather than behavioral features alone – claim that it should not be motivated by external rewards</td>
<td rowspan="2">Definitions:
Play – (according to the authors) voluntary, with attention to the process rather than an end goal; flexible and spontaneous; free from constraints of reality; pleasurable and safe
Functional play – using an object for its intended function
Symbolic play – individual treats an object as if it is something else; includes referring to an object as something else, attributing properties to an object that it does not have, referring to an object that is not really there</td>
<td>Inclusion requirements:
Behavioral, often-used, and research-based techniques

PsychInfo search

Used Stahmer et al, (2003) as a guide</td>
<td rowspan="2">Results:
Total of 41 articles
13 "hard" claims articles
• Not all procedures used were strictly behavioral in the traditional sense (or at least what the author thinks of as the traditional sense)
• Authors argue that interventions that simply teach children to imitate play behaviors are not truly teaching play (which I tend to agree with)
• Authors are concerned that although play behaviors may increase with intervention, the quality of play remains different and is not being addressed by interventionists</td>
</tr>
<tr>
<td>Limitations:
Pretend play section – some of the studies discussed were unpublished

"dispositional change," as the authors called it, may have occurred in participants but was not measured, and therefore not reported</td>
</tr>
<tr>
<td colspan="2">Tx Integ./Reliability:
Articles indep. assessed by the first two authors and categorized as "hard" or "soft" (see article for clarification) – 89% agreement</td>
<td colspan="2">Future research:
Include measures of quality
More research on process involved in generalization
Use of randomized control trials and longitudinal studies
Authors suggest that a separation between the cognitive and behavioral literature is a problem</td>
</tr>
</table>

Reference: MacDonald, R., Clark, M., Garrigan, E., & Vangala, M. (2005). Using video modeling to teach pretend play to children with autism. *Behavioral Interventions, 20,* 225-238.

<table>
<tr><td>Purpose:
Extend D'Ateno et al. by teaching children with ASD to engage in long sequences of play</td><td>Setting & participants:
specialized preschool classroom

2 boys, ages 4 and 7, PDD-Autism</td><td rowspan="3">Materials:
3 play sets - town, ship, house; each w/base structure and 7 characters or objects; scripts made for each set - 156 verbalizations and 14 play actions</td><td rowspan="3">Results:
Video modeling was effective in increasing scripted play actions across play sets; unscripted play did not emerge; future research should find a way to systematically increase unscripted play</td></tr>
<tr><td></td><td>Experimental design:
multiple probe design across play sets
(same order for each child)</td></tr>
<tr><td>IV:
Video - shown 2 times consecutively immediately before session</td><td>DV:
# of scripted verbalizations (per video); # of play actions; # of unscripted play actions (BL and probe)</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
40% of sessions for scripted verbalizations (90%) and actions (97%);</td><td colspan="2">Generalization/Maintenance:
Scripted actions seemed to maintain at high levels in follow up probes</td></tr>
</table>

Reference: MacManus, C., MacDonald, R., & Ahearn, W. H. (2015). Teaching and generalizing pretend play in children with autism using video modeling and matrix training. *Behavioral Interventions, 30,* 191-218.

<table>
<tr><td>Purpose:
Examine video modeling and matrix training for teaching children with autism sequences of play (incl multiple vocs and motor actions with toy play sets that have figurines and objects)

Determine whether generalized play will emerged across unlearned/novel combos in related toy play sets</td><td>Setting & participants:
Small room with table and chair, play materials on the floor
3 male preschool student in intensive behavioral program, all with ASD</td><td>Materials:
Bank play set; Marvel Superhero Squad toys; mansion play set; action figure toys; castle play set

Each with a playset, two characters, one object, one vehicle</td><td rowspan="3">Results:
Video modeling increased extended sequences of scripted play for all three

Matrix training was successful in producing generalization across three combos of play sets and materials for all three participants

Unscripted vocs increased for all three participants after intro of video modeling, esp. after acquisition of two of the three playsets (for two of the three, this happened after they completed the scripted story)

Two of three participants began engaging in novel play after they completed the training video modeling scripts</td></tr>
<tr><td></td><td>Experimental design:
Multiple probe across participants

Multiple probe across play sets within participants</td><td rowspan="2">Limitations:
• Issues with fine motor manipulation of some of the toys
• Materials did not always remain upright (used carpeted floor – more unstable)
• Limited number of alternative probes with Shane due to his leaving the preschool
• May have acquired known materials faster
• May have needed longer session times
• No follow-up in natural setting
• All three sets had very similar story lines</td></tr>
<tr><td>IV:
Adult video model including three scenes

Matrix training protocol</td><td>DV:
Percentages of actions and vocalizations completed in the response chain for each play set (scripted actions, scripted vocalizations, recombined actions, recombined vocalizations, unscripted vocs)</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
IOA – at least 33% of sessions (lowest overall was 82.9, highest was 100)
Tx. Integ not reported</td><td colspan="2">Generalization/Maintenance:
None reported outside of the purpose of the study</td></tr>
</table>

Reference: Miller, N., & Neuringer, A. (2000). Reinforcing variability in adolescents with autism. *Journal of Applied Behavior Analysis, 30* (2), 151-165.

<table>
<tr><td rowspan="2">Purpose:
Answer the following question:
• Would variability of responses of children with autism increase if directly reinforced?</td><td>Setting & participants:
One experimental group, 3 males, 2 females - adolescents with autism (12-17 years)</td><td>Materials:
Computer connected to two large mouse buttons
Computer game in which they were asked to respond under one of two conditions</td><td rowspan="2">Results:
RF values lower at end of VAR phase for 3 participants w/ASD, and lower at the end of PROB2 for all participants

Levels of variability were higher when that dimension was specifically reinforced (VAR) as compared to the initial baseline

High variability continued during reversal to PROB2 contingency for all groups

Levels of variability were lower in participants with autism as compared to an adult control group</td></tr>
<tr><td>Experimental design:
ABA reversal design, as well as control group comparisons (adult and child)</td><td rowspan="2">Limitations:
• Comparison groups differed in chronological age
• Participants with ASD had co-existing disorders and were on medication that could affect variable responding
• Sr+ were qualitatively different across groups
• Failure to reverse effects – experimental control?
• Percentile reinforcement schedule may be difficult to use in natural settings</td></tr>
<tr><td>IV:
VAR Sr+ contingenies: relatively infrequent patterns were reinforced based on a calculation
PROB Sr+ contingencies: task was same as VAR, but Sr+ given with probability of .5 independent of performance
Training sessions occurred prior to intervention</td><td>DV:
Average relative frequency (RF) value – lower #s = more variable sequences (more recent responses)
U value (0-1) – higher values = higher variability (more molar)</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
Not reported</td><td colspan="2">Generalization/Maintenance:
Effects of VAR phase (i.e. higher variability in responding) maintained during reversal phase</td></tr>
</table>

Reference: Murray, C., & Healy, O. (2015). An examination of response variability in children with autism and the relationship to restricted repetitive behavior subtypes. *Research in Autism Spectrum Disorders, 11,* 13-19.

<table>
<tr><td rowspan="2">Purpose:
Use the Penny Hiding Game as a test of response variability
• Investigate difference in levels of variability shown by participants with and without ASD
• Determine whether lower bx variability was related to higher rates of restricted repetitive behaviors (RRBs) among participants with ASD
• Determine whether particular categories of RRBs would be more or less related to low variability in ASD</td><td>Setting & participants:
Schools or homes of participants, quiet corner

65 children with ASD (56 male); 65 typically-developing children (27 male)</td><td>Materials:
Penny</td><td rowspan="2">Results:
• Typically-developing participants engaged in significantly more variability that participants with autism (larger sample size than previous studies)
• High levels of RRBs were correlated with low variability – significantly related to higher levels of stereotypy and SIB
• Low variability not significantly correlated with insistence on sameness or circumscribed interests

• Supports interventions focused on reinforcing variable behaviors (p. 18)</td></tr>
<tr><td>Experimental design:</td><td>Limitations:
• Did not investigate relationship b/w variability and intellectual functioning or verbal ability
• No data to support the reliability or validity of the penny hiding game to date</td></tr>
<tr><td>IV:
RBS-R conducted pre- and post-intervention

Penny Hiding game:
Condition 1: 3 phases of 4 trials each – no-lose, no-win, real game
Condition 2: participant hid coin – 6 trials</td><td>DV:
Repetitive Behavior Scale-Revised (RBS-R) (43 items on a 4pt Likert scale)

Scored patterns of variability in the game</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
Not resported</td><td colspan="2">Generalization/Maintenance:
Not reported</td></tr>
</table>

Reference: Napolitano, D. A., Smith, T., Zarcone, J. R., Goodkin, K., McAdam, D. B. (2010). Increasing response diversity in children with autism. *Journal of Applied Behavior Analysis, 43*, 265-271.

<table>
<tr><td>Purpose:
Extend Goetz and Baer (1973), with included changes from studies on increasing variability in verbal responses of individuals with ASD</td><td>Setting & participants:

1 girl and 5 boys with ASD (6-10 years)</td><td>Materials:
24 8-peg plastic building blocks (6 blocks of 4 primary colors) and reinforcers</td><td rowspan="3">Results:
Variable responding increased for all participants with intervention – additional teaching necessary for some participants, but overall was an effective procedure</td></tr>
<tr><td></td><td>Experimental design:
ABAB withdrawal design</td><td rowspan="2">Limitations:
Lack of reversal for 2 participants, partial for 1

Stated “build differently” during intervention – may have increased likelihood of understanding the contingency

No generalization probe prior to intervention for a comparison</td></tr>
<tr><td>IV:
Lag 1 reinforcement schedule; teaching trials (if Lag 1 did not produce improvements)</td><td>DV:
Variant or invariant form, variant or invariant colors</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
IOA – 44% of sessions across 6 participants – agreement was 92% across all sessions
Tx Integ – collected for 34% of sessions – mean of 96% fidelity</td><td colspan="2">Generalization/Maintenance:
Wooden blocks of similar size and color as plastic blocks used – only 1 participant had high rates of responding in generalization

Collected 2-3 months after intervention – same as Lag 1 condition – some maintained at higher levels than others</td></tr>
</table>

Reference: Newman, B., Reinecke, D. R., & Meinberg, D. L. (2000). Self-management of varied responding in three students with autism. *Behavioral Interventions, 15,* (145-151).

<table>
<tr><td>Purpose:
Teach self-management skills to students with autism to increase varied responding in play and social language

To use self-management skills to promote generalization and maintenance</td><td>Setting & participants:
School program for children with autism (2), home setting (1)

3 participants, 2 were age 6, 1 was in preschool, autism (2 boys, 1 girl)
Each spoke in full sentences</td><td>Materials:
Toy robot
Drawing materials
Tokens
Back-up reinforcers (candy, time in the computer room or gym, etc.)</td><td rowspan="3">Results:
All 3 students self-managed behavior appropriately
Increase in variability for all three students

None of the students ever took all earned tokens during a session (were not more than 60% accurate), but bx was still affected</td></tr>
<tr><td></td><td>Experimental design:
Multiple baseline</td><td>Limitations:
None stated by authors – but the procedure did vary somewhat across participants as far as the materials, the verbal prompts given, etc.

Really, given that there were only 10 opportunities per session, they did not have to vary that much to be considered “variable”</td></tr>
<tr><td colspan="2">IV:
Students were asked at the outset of the day’s observations to vary responding
Students were prompted 10 times to engage variably (a prompt was in the form of a verbal question)
Sr+ with social praise and tokens
Self-management: students told to take a token when he or she displayed variation – verbal prompt for 6 days to take a token when necessary or to stop taking a token when they should not</td><td>DV:
Degree of variation in target behavior selected for each student (i.e. had not been emitted previously during the session by child or experimenter) – 10 opportunities per session

Target bxs: play with toy robot, social conversation, drawing</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
Not stated</td><td colspan="2">Generalization/Maintenance:
Follow-up collected at 1 month with identical conditions to self-management phase
Increase in variable responding was maintained at follow-up</td></tr>
</table>

Reference: Page, S., & Neuringer, A. (1985). Variability is an operant. *Journal of Experimental Psychology: Animal Behavior Processes, 11* (3), 429-452.

<table>
<tr><td>Purpose:
Reinforce variability in an environemtn similar to Schwartz (1980) to explain his negative results
Demonstrate that variability is a reinforcable dimension of behavior and that it is sensitive to discriminative stimulus control</td><td>Setting & participants:
3 pigeons, 80% of free-feeding body weight

Experimental design:
ABA or ABAB reversals</td><td>Materials:
Operant chamber
Grain pellets
Two available keys

Limitations:
Studies on variability may make it impossible to predict and control the next instance of variable bx, but “operant analysis must not limit itself to predictable and controllable behaviors. Doing so ignores an essential characteristic of operant behavior” (p. 451)</td><td rowspan="2">Results:
• Six experiments indicated that variability can be controlled by contingent reinforcement in the much the same way as any other operant behavior
• Variability was increased, decreased, and maintained depending on the contingencies of reinforcement placed on it
• Different schedules of Sr+ resulted in different levels of variability
• They discuss variability’s importance in relation to freedom, stating that, “To maximize freedom, an animal or person must have a wide variety of experiences…Contingencies that explicitly reinforce behavioral variability are necessary to maximize freedom” (pp. 451).</td></tr>
<tr><td>IV:
Differed for each of the 6 experiments, but involved pretraining and different requirements of variability in key pecking patterns on two keys
Requirements were expressed in terms of lag schedules, and when all the way up to Lag 50</td><td>DV:
Variable responding on two keys</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
None reported</td><td colspan="2">Generalization/Maintenance:
None reported</td></tr>
</table>

Reference: Parsonson, B. S., & Baer, D. M. (1978). Training generalized improvisation of tools by preschool children. *Journal of Applied Behavior Analysis, 11*(3), 363-380.

<table>
<tr><td>Purpose:
Discover whether preschool children displayed generalized skills of improvisation (i.e., problem solving) independently, and if not, whether they could be taught to do so, and whether these skills would then generalize to other problems</td><td>Setting & participants:
University preschool program; research room

5 children, 3 typical, 2 with language or behavioral issues

Experimental design:
Within-subject multiple baseline and between-subject multiple baseline

Phases: BL, training, follow-up</td><td>Materials:
Tasks: Pounding on a pounding toy, storing marbles, lacing shoe – each required problem solving using its respective tools
Exemplars of possible tools

Limitations:
Subjects may have had more experience with hammers and containers that shoelaces, leading to better effects seen in these groups</td><td>Results:
Few new improvisations in baseline

Training increased the number of improvisations overall for all subjects, but was most effective with hammers and containers

Generalized improvisations occurred most often in training phase</td></tr>
<tr><td>IV:
Pick-ups, attempts, improvisations</td><td>DV:
Training procedure: Training sufficient exemplars and training to generalize</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
IOA – 50% of sessions across all phases (all scores above 83.8%)</td><td colspan="2">Generalization/Maintenance:
(see results)</td></tr>
</table>

Reference: Rodriguez, N. M., & Thompson, R. H. (2015). Behavioral variability and autism spectrum disorder. *Journal of Applied Behavior Analysis, 48* (1), 167-187.

Purpose: • Describe how restricted and repetitive behavior can be conceptualized as problems of invariance • Consider the implications of a lack of varied responding for indiv. with ASD • Review relevant basic and applied lit on response variability • Present methods to address invariant responding in those with ASD • Suggest areas for future research	**Results:** There are many potential methods for treating invariant responding: • Extinction-induced variability • Differential reinforcement of variable responding (or novel responding) – including lag schedules of reinforcement • Prompting variable responding (typically used if differential reinforcement is not enough)
Suggested areas of future research: Increasing ITIs, looking at how to maintain responding without making the Sr+ schedule too lean, establishing stimulus control for variable responding, analyze reinforcing properties of automatically reinforced bx, how to establish generalized variable responding, evaluate the role of limited exposure to changing contingencies on invariable responding (e.g. scheduled activities), normative measures	

Reference: Sani-Bozkurt, S., & Ozen, A. (2015). Effectiveness and efficiency of peer and adult models used in video modeling in teaching pretend play skills to children with autism spectrum disorder. *Education and Training in Autism and Developmental Disabilities, 50*(1), 71-83.

<table>
<tr><td rowspan="2">Purpose:
Compare two kinds of models in video models for teaching play skills:
1) Does effectiveness differ between the two in acquisition, generalization, and maintenance?
2) Is efficiency different in presentation between the two?
3) What are parent opinions of each?</td><td>Setting & participants:
Training room; physiotherapy room. The materials needed to carry out the steps of the skills were arranged on the table in such a way as to be easily reached by the participant after having watched the videos.

3 (2 boys and 1 girl), 5-6 years, autism</td><td rowspan="3">Materials
Laptop and video camera
Paper and pen data sheets

Soup cooking play: toy stove, pan, glass, plate, spoon, soup packet, trash can table
First aid play: doll, cupboard, toy medicine bottle, plasters, gauze, plastic bowl, trash can, table
*Different sizes and colors used in generalization sessions</td><td rowspan="3">Results:
Effectiveness = no different between peers and adults

Overall, no significant different in efficiency</td></tr>
<tr><td>Experimental design:
Adapted alternating treatments design from a single subject design model</td></tr>
<tr><td>IV:
The peer and adult models used in the video model teaching</td><td>DV:
1.) Cooking soup play 2.) First aid play. (Different for each participant and were pairs of chained skills as the level of difficulty and equal or very close in number of task steps (15 steps))</td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
30% of sessions during all phases – 100% for both</td><td colspan="2">Generalization/Maintenance:
Play skills maintained (7, 14, and 28 days after)

Play skills generalized to other people, environments, and materials</td></tr>
</table>

Reference: Smith, T. (2001). Discrete trial training in the treatment of autism. *Focus on Autism and Other Developmental Disabilities, 16* (2), 86-92.

Purpose:	**Results:**
Discuss how DTT has been used to teach different skills to children with autism Provide cautions about the use of DTT Discusses potential need to combine DTT with other teaching procedures, training and expertise needed to use DTT, and amount of DTT needed for proper treatment	Skills taught with DTT: • New behaviors/forms of behavior • Discriminations • Imitation • Receptive language • Exp. Language • Conversation • Grammar • Various forms of communication • Expanding vocabulary • Social interactions • Play skills (ranging from simple to complex) pg. 89 • Decreasing prob. bx

Reference: Stahmer, A. C. (1995). Teaching symbolic play skills to children with autism using pivotal response training. *Journal of Autism and Developmental Disorders, 25* (2), 123-141.

<table>
<tr><td>Purpose:
• Assess the feasibility of teaching symbolic play skills to children with ASD using PRT
• Examine individual differences that affect acquisition of these skills
• Assess generalization and maintenance of bx changes across setting, playmates, and toys
• Examine changes in interaction skills after symbolic play training
• Examine changes in symbolic play relative to the play of language-matched typical controls
• Control for the effect of interaction with an adult and exposure to toys alone on play skills</td><td>Setting & participants:
Setting varied per participant
7 male children w/ASD – all younger than 7.5 years and with a mental age of at least 2.5 years

7 language-matched typical children served as playmates (BL probe, post-int probe, follow-up probe)

Experimental design:
Multiple BL across subjects</td><td>Materials:
Training: Tea set, adult male doll, Barbie family, Disney mickey town jet set, tool set, + some placeholder items

Generalization: Pool set, picnic basket, farm animals, + placeholder items

Limitations:
• No measures of social validity
• Did not generalize skills well to peers
• No direct training with peers</td><td>Results:
• All 7 participants with autism showed an increase in symbolic play and play complexity after training
• After training, an average of 35% of symbolic play actions were creative (i.e. not trained) – range = 9-56%
• Range of performances across different participants
• In general, interaction skills improved during and after training
• There may be a language threshold at which this type of intervention becomes appropriate (at which point it is likely to be effective)
• Children with ASD performed at similar levels to typical peers after training</td></tr>
<tr><td>IV:
BL = standardized test assessments
Free play assessment
Symbolic play training – PRT (detailed description on page 130)
Language training – same as above training, but language was the target (classic PRT)</td><td>DV:
Language assessments; symbolic play behavior (see p. 128); play complexity (see p. 128); Creativity of play – defined as novel (i.e. symbolic play themes not learned during training); interaction during play (initiations and responses)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Tx Integ./Reliability:
1/3 of each child's sessions were scored by blind observers via video recordings of sessions; symbolic play – 85%; complexity – 77%; initiations – 71%; initiations – 87%</td><td colspan="2">Generalization/Maintenance:
3 month follow-up: 5 of the 7 children decreased some play skills at follow-up, but all still remained at higher levels than pretraining
Generalized skills to new settings and toys, and other adults – not as well to peers
Spontaneous play actions occurred in the absence of adults</td></tr>
</table>

Reference: Stahmer, A. C., Ingersoll, B., & Carter, C. (2003). Behavioral approaches to promoting play. *Autism, 7* (4), 401-413.

<table>
<tr>
<td rowspan="3">Purpose:
Provide a review of behavioral methodologies that have been used successfully to teach play skills to children with ASD.
(Focus on play with objects)
Methods reviewed:
• Discrete trial training (DTT)
• Use of stereotyped bx
• Pivotal response training (PRT)
• Reciprocal imitation training (RIT)
• Differential Sr+ of appropriate bx
• Self-management training
• In vivo modeling and play scripts
• Video modeling</td>
<td>Setting & participants:
Inclusion criteria not listed</td>
<td rowspan="3">Results:
DTT – uses explicit prompting and shaping and systematic Sr+; effective in teaching many types of play, from simple to complex
Stereo. Bx – perseverative themes used to create appropriate games
PRT – designed to increase child motivation; naturalistic method, but structured enough to allow for creativity; uses modeling and imitation; has been successful increasing spontaneous creative play in children with ASD; play with peers did not increase after training – may need more direct training for this
RIT – variation of PRT; developed for spontaneous imitation skills; children with ASD learned imitative pretend play with adult; some participants increased spontaneous pretend play
Differential Sr+ - mixed results (used for both leisure and play); may be most effective for increasing the period of engagement in a previously acquired play skill, may need a combo of this and another teaching technique for acquisition
Self-management – Newman et al (2002): 3 participants increased variability in play after self-management training; successfully increased social initiations and independent interactions with peers
In vivo modeling/play scripts – effective in teaching sociodramatic play, appropriate play
Video modeling – used to increase play actions, duration, and statements</td>
</tr>
<tr>
<td>Limitations:
Did not address social play in depth</td>
</tr>
<tr>
<td>Generalization/Maintenance:
DTT – studies have shown that skills are maintained and generalized to novel settings, including classroom
PRT – did not generalize to social play
RIT – generalized to novel setting, therapists, and materials (for one study)
Self-management – maintained at 1 month follow-up
In vivo/play scripts – increased social play activities following training</td>
</tr>
</table>